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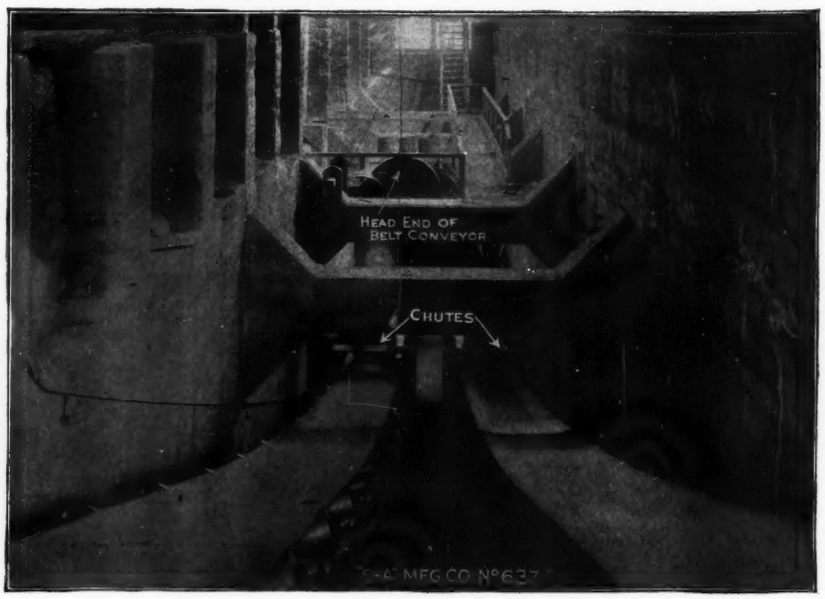

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Engineering and Mining Journal

VOLUME 102 JULY 22, 1916 NUMBER 4

The Boulder County Tungsten District, Colo.

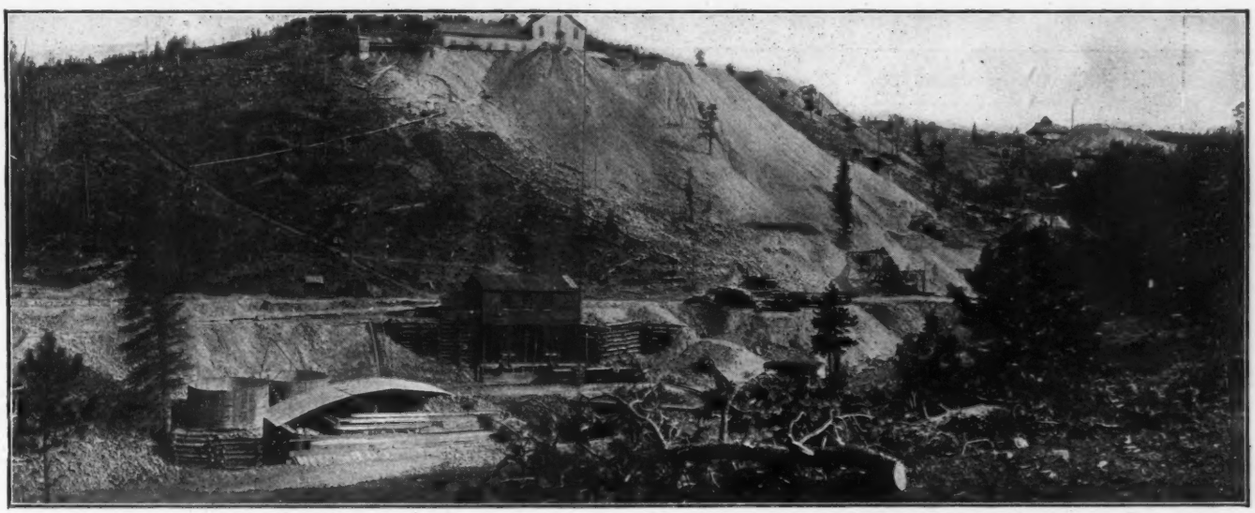
By Harry J. Wolf* and Percy P. Barbour†

SYNOPSIS—This district first became known to mining about 1870, when Sam P. Conger discovered the Cariboo silver mine. The first tungsten ore was produced in 1900. The common tungsten mineral of the district is ferberite. Minerals usually associated with tungsten in other parts of the world are absent. The orebodies are lenticular and pockety.

The Boulder County tungsten district is situated about 25 mi. northwest of Denver, Colo. The promising deposits extend southward into the northern end of Gilpin County. The tungsten-bearing area has a northeast and southwest length of about 12 mi. and a width of about 7 mi.

The more important towns in the district are Nederland, Cardinal, Phœnixville, Rollinsville, Sugarloaf, Magnolia, Lakewood and Stevens Camp. The principal active mining centers in the heart of the district are Nederland, (the chief commercial town), Lakewood and Stevens Camp. The population of Nederland and adjacent territory is about 4,000, Lakewood has about 400 people and Stevens Camp about 500. The entire population of the district is in round figures 5,000. The altitude of Nederland is 8,237 ft. above sea level.

The district is reached by the Colorado & Northern R.R., which runs from Boulder to Sugarloaf and Cardinal. The latter station is about 2 mi. from Nederland. The Denver, Northwestern & Pacific R.R. (Moffatt Road) runs from Denver to Rollinsville, about 4 mi. south of Nederland. The various towns of the district may be reached also by auto stage from Boulder. Nederland is about 12 mi. west and 3 mi. south of Boulder. At the present time there is considerable activity in road building due to the great volume of automobile traffic between Boulder and the district. Several gangs are at work widening the roads and reducing grades and curves. Considerable freighting is done with auto trucks, which have played an important part in the development of the camps. Most of the small hoisting plants now in operation in the district have been installed since Jan. 1, 1916, and Stevens Camp has been entirely built within this period.



CONGER MINE OF THE BOULDER COUNTY TUNGSTEN DISTRICT, COLO., AND BEDDIG MINE IN THE BACKGROUND

The area is on the Front Range about 3 mi. west of the nearest sedimentary rocks. The most important country rock is biotite-horne-blende granite. Other prominent rocks are gneissoid granite, gneiss, fine-grained granite, quartz-mica, schist and pegmatite. The granite, gneiss and schist are of pre-Cambrian age. The gneiss and schist are older than the granite. The pegmatite is frequently coarsely crystalline and is usually in dikes cutting the older rocks. Minerals going to form the veins are described in another paragraph.

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†Mining engineer, Idaho Springs, Colo.

The principal ore-forming mineral of the district is ferberite, one of the four commercial tungsten minerals; the other three being wolframite, hübnerite and scheelite. Ferberite is almost entirely iron tungstate, although analyses of typical specimens indicate the presence of small amounts of manganese, calcium and magnesium oxides, silica and alumina. The ferberite in the Boulder County field is usually black but occasionally brown. It is found in finely crystallized compact masses and also in well-developed crystals, wedge-shaped and with rhombic faces. The crystallization appears to be monoclinic in character. The finely crystallized ferberite is found frequently embedded in or closely associated with quartz, and this ore is commonly called "horn rock" by the miners. The vein-forming minerals are frequently brecciated, and fragments of rock varying in size from fine particles to pieces 2 to 3 in. in diameter are embedded in the ferberite. This is referred to as "peanut ore." Sometimes the ferberite occurs in fine particles disseminated throughout the quartz, and fine crushing of the ore is required to liberate it for successful concentration.

TWO OF THE COLORADO TUNGSTEN MILLS; FIRST THE PRIMOS AND THEN THE WOLF TONGUE

VIEWS OF THE RAKE OFF MINE AND THE CLYDE TUNNEL IN THE BOULDER COUNTY TUNGSTEN DISTRICT

The more prominent and most promising veins of the district have a northeast and southwest strike. Veins are frequently in coarsely crystalline pegmatite. As in the case of most veins carrying valuable minerals, crossings and junctions are likely to be accompanied by enrichment. It seems to be a common belief among the miners in the district that the quality of the ore is likely to be improved just west of a junction or dike crossing the vein at an acute angle. Dikes crossing the veins at right angles are supposed to have little influence on the ore. Watercourses are considered favorable indications. Other popular beliefs are that the appearance of schist in the vein is unfavorable and is likely to cut off the ore and that the best ore is more likely to be found in the more acid than in the more basic rocks. The ferberite is frequently found in fine stringers in decomposed granite, with or without small seams of quartz. In the northern part of the district the ferberite is sometimes grayish or brownish in color, while in the southern part it is usually an intense black. The latter characteristic is common of the Beaver Creek locality.

The orebodies are commonly in the form of small lenses a few feet in length. Sometimes these lenses are larger, and exceptional orebodies have reached a length of 150 to 200 ft. Up to the present time the development of the district may be regarded in a general way as somewhat superficial, for most of the mines are less than 300 ft. deep and more than half the properties have reached a depth of less than 200 ft. The Conger mine, with a depth of 1,100 ft., and the Beddig mine, with 600 ft., are the exceptions and represent the deepest development in the district. There are three steam hoists and 58 small electric hoists in operation. This number of small hoists is suggestive of the number of relatively shallow shafts being sunk for development purposes. The accompanying table of some of the more prominent shafts will convey a general idea of the depth of development.

MINE DEVELOPMENT OF THE DISTRICT

Name of Mine	Depth of Shaft, Ft.	Name of Mine	Depth of Shaft, Ft.
Conger	1,100	Cross No. 2	198
Beddig	600	Cross No. 1	190
Cold Spring	350	Lily	130
Clyde	300	Orange Blossom	140
Star	280	Tenderfoot	140
Oregon	260	Crow No. 1	130
Vasco No. 7	260	Bonanza No. 2	117
Forest Home	220	Last Chance	100
Town Lot	210	Jack	100
Pansy	200	Summit	100
Bonanza No. 1	200	Crow No. 11	60

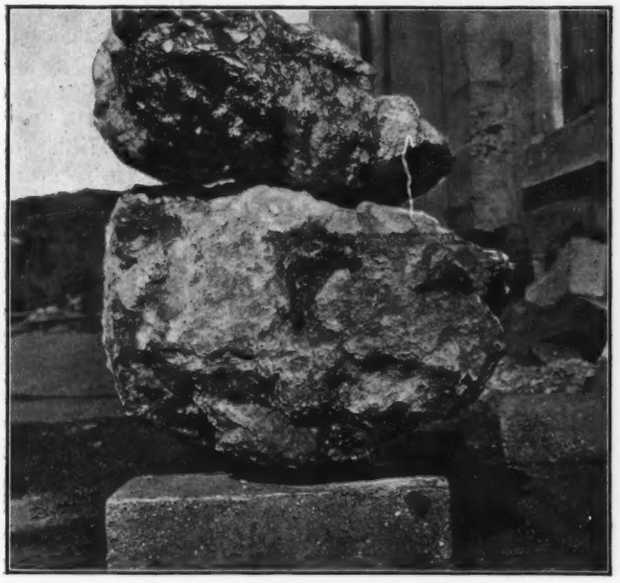
The tungsten properties may be roughly divided into large, moderate and small producers. Large producers

are found in three localities: The area including the Conger properties, Sherwood Creek and Lakewood, north and west of Nederland; Stevens Camp, to the east of Nederland; and Beaver Creek, to the south. Among the moderate producers are such properties as the Red Sign and Lucky 2 mines, located in Middle Boulder Cañon, and the Eagle Rock property at Duncan Camp; and the properties in the Rollinsville section south of Nederland. Small producers and properties in process of development are found in some of the districts that include promising properties under development, such as Manchester, Gordon Gulch, Bummer's Gulch, Dry Lake, Loveland Camp, Pullian's Camp and Roger's Tract.

Chief Operating Companies

The principal companies operating in the district are the Wolf Tongue Mining and Milling Co., the Primos Mining and Milling Co., the Vasco Mining Co. and the Boulder Tungsten Production Co. In addition to these, which control the bulk of the production, there are numerous small companies and private operators.

The Wolf Tongue Mining and Milling Co. controls and operates the following mines: Clyde, Cold Spring, Star, Cross No. 1, Cross No. 2, Pansy, Orange Blossom, Tenderfoot, Last Chance, Town Lot, Oregon, Bonanza No. 1, Bonanza No. 2, Jack and Summit. About forty



SOME OF THE TYPICAL TUNGSTEN ORE

sets of lessees are at work in these properties. The Clyde mine, about 1½ mi. northeast of Nederland, is operated on company account. The main shaft is 300 ft. deep. A tunnel, part of which is a crosscut, connects with the shaft at a point 230 ft. below the collar. The tunnel cuts the vein at a point 569 ft. from the portal and from this point advances as a drift on the vein a distance of 85 ft. to the shaft. The general strike of the Clyde vein is northeast and southwest, and the dip is about 70° northwest. The principal shoot being worked at present is about 160 ft. long. The ore as mined carries from 3 to 4% tungstic acid and is shipped direct to the mill without sorting. The vein is alongside a pegmatite dike. The method of mining is similar to that employed in shrinkage stoping. The ore is broken down in the stope, and the miners work on top of the ore. The muck line is kept at a convenient distance from the back of the stope by drawing off the excess broken ore through chutes into tramcars in the levels. It is estimated that the gross production of this mine to date is about $80,000. The Wolf Tongue company controls parts of Secs. 5, 7 and 8, in T. 1 S, R. 72 W.

The Primos Mining and Milling Co. operates the Conger, Beddig, Lily, Crow and other mountain-ranch tracts. About 75 sets of lessees are working in these properties. The Conger mine, about one mile northwest of Nederland, is operated on company account. The main Conger shaft is 1,100 ft. deep. The first level is a tunnel level and connects with the shaft at a point 160 ft. below the collar. The other levels are about 100 ft. apart. On the 200-ft. level the mine is connected with what is known as the old Conger mine to the southwest. The old shaft is operated by lessees. Until recently the company has been sinking the main shaft. The hoisting plant is operated by steam. The shaft is vertical and is equipped with a single-deck cage. The mine cars used are 2 ft. by 2 ft. 3 in. by 3 ft. 3 in. and hold about one ton of ore. The Conger is shipping about 50 tons of ore a day. The ore is hauled over a surface tramway by electric locomotive to the Primos mill. Approximately 120 men are employed in and about the property. This is the largest single producer in the district. The vein has a northeast and southwest strike, and the dip is nearly vertical. The ore is typically brecciated. The Primos company controls section 1 and parts of Sec. 11 and 12, in T. 1 S, R. 73 W and part of Sec. 6, in T. 1 S, R. 72 W.

The Vasco Mining Co. operates nine properties located in the southwest quarter of Sec. 8, T 1 S, R. 72 W. Among the properties owned and operated by the Boulder Tungsten Production Co. are the Forest Home and Clark Tunnel. The Colorado Tungsten Corporation controls part of Sec. 12, in T. 1 S, R. 73 W.

In addition to the four large companies mentioned, there are many small companies and individual operators. The small plants shown in the accompanying illustrations are characteristic of the district. It is a district of small operators, small capital, small plants and small shipments. In some respects it may be called a "poor man's camp." Current wages range from $3.60 to $4.20 a day.

The bulk of all ore produced in the district is mined by lessees who develop and work small blocks of ground on short-time leases. Most of the ore shipments are small, and the lots of ore are usually hauled by wagon from the mine to the purchaser. The four large companies named buy practically all the ore produced in the district. These companies naturally favor their own lessees first and then buy ore from outsiders if they can handle it to advantage.

The current leasing practice of the Wolf Tongue Co. is to grant a lease on a block of ground for a period of one year with the usual understanding that it will be renewed for an additional year if the work accomplished by the lessee is satisfactory to the company. After the lessee has performed 30 ft. of sinking, the company may supply him with machine drills and compressed air, sometimes an electric hoist and other equipment, and pay half his expense for labor. Under this arrangement the lessee ships his ore to the company and receives therefor the "prevailing" price at the company's mill. This price has recently ranged from $15 to $20 per unit of tungstic

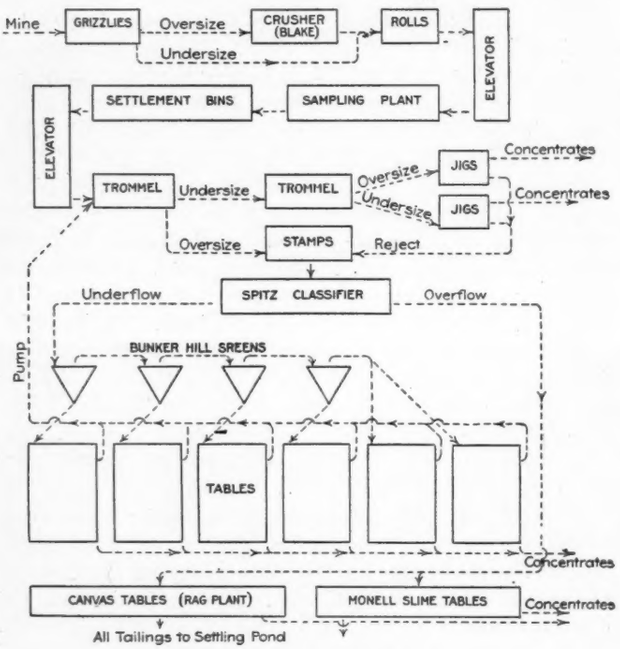
acid on a basis of 60% tungstic acid in the ore. From the net proceeds after deducting treatment charges the company takes 25% royalty.

The common practice of the other three operating companies is to buy the ore from the lessee at current market price and charge a royalty of 25% of the net proceeds after deducting milling and sampling charges. The Primos company usually grants a lease for a period of six months, while the Vasco and Boulder Tungsten companies grant a lease for one year.

Some of the Ore Schedules

The schedules of prices paid for the different grades of ore have varied from time to time with the market for tungsten. The accompanying table shows an example of a recent schedule.

Many of the current leases cover operations involving the working over of old dumps. Some of these operations consists of simple sorting, but several lessees have installed comparatively elaborate washing, sorting and concentrating equipment. The nature of the treatment in use varies with the ingenuity and ability of the operator. Some of the installations include only such screening and jigging apparatus as can be operated by a 2- or 3-hp. gasoline engine. The larger installations include hand sorting, grizzlies, revolving screens, jigs and Wilfley or Card concentrators. Usually three products are made: High-grade crude ore, hand-cobbed milling ore—which requires further treatment at the company's mill—and waste.



FLOW SHEET OF TUNGSTEN MILL

Mills and Milling Practice

Some of the more important mills of the district are the Wolf Tongue, Primos, Ardourell, Eagle Rock, Clark, Clarasdorf, Hildreth, and Vasco, the last under construction. The Colorado Tungsten Corporation has a mill at Boulder. Other plants are in contemplation.

One of the chief difficulties in milling has been the tendency of the ferberite, due to its perfect cleavage and its friability, to slime when crushed in the stamp battery. Much of the slimed ferberite has been recovered by the use of slime tables and canvas tables. Recoveries range from 65 to 85%. Following is an outline of current milling practice. The ore is passed over a 2-in. grizzly, from which the undersize is passed to a stamp battery. The oversize is crushed and delivered to the stamps. The stamps used vary in weight from 750 to 950 lb. each. The number of drops per minute ranges from 70 to 90. The drop is usually low and ranges from 4½ to 6 in., and from 12- to 20-mesh screens are used. The pulp from the batteries is classified and distributed to Wilfley or Card tables upon which the first concentrate is made. The tailings are frequently classified and again delivered to tables, or sometimes Frue vanners. Both 4- and 6-ft. vaners are in use. The tailings from the second concentration on either tables or vanners are sometimes recrushed in a Huntington mill with a 60-mesh screen, and the product is treated on slime or canvas tables. This outline is subject to considerable modification in different mills. In some of the plants, ordinary Harz jigs are employed to advantage and revolving screens are used for sizing. Both Wilfley and Card tables are in use, but

THE WOLF TONGUE MINING COMPANY SCHEDULE FOR TUNGSTEN ORES

Effective June, 20, 1916

Schedule of prices paid for tungsten ore delivered at the Wolf Tongue Mill, Nederland, Colo. Subject to change without notice.
In lots less than $50 a charge of $3 will be made for sampling and assaying; also on lots assaying less than 2%, a charge of $3 per ton will be made for sampling and assaying. Otherwise no charge will be made.

1%	15c. per lb. for Tungstic Acid	$3.00 per ton
2%	22.5c. per lb. for Tungstic Acid	9.00 per ton
3%	32.3c. per lb. for Tungstic Acid	19.40 per ton
4%	36.5c. per lb. for Tungstic Acid	29.20 per ton
5%	39.0c. per lb. for Tungstic Acid	39.00 per ton
6%	40.6c. per lb. for Tungstic Acid	48.80 per ton
7%	41.8c. per lb. for Tungstic Acid	58.60 per ton
8%	42.7c. per lb. for Tungstic Acid	68.40 per ton
9%	43.7c. per lb. for Tungstic Acid	78.80 per ton
10%	44.0c. per lb. for Tungstic Acid	88.00 per ton
11%	44.4c. per lb. for Tungstic Acid	97.80 per ton
12%	44.7c. per lb. for Tungstic Acid	107.40 per ton
13%	45.2c. per lb. for Tungstic Acid	117.60 per ton
14%	45.4c. per lb. for Tungstic Acid	127.20 per ton
15%	45.6c. per lb. for Tungstic Acid	137.00 per ton
16%	45.6c. per lb. for Tungstic Acid	146.00 per ton
17%	46.0c. per lb. for Tungstic Acid	156.60 per ton
18%	46.2c. per lb. for Tungstic Acid	166.40 per ton
19%	46.3c. per lb. for Tungstic Acid	176.20 per ton
20%	46.5c. per lb. for Tungstic Acid	186.00 per ton
21%	46.6c. per lb. for Tungstic Acid	195.80 per ton
22%	46.7c. per lb. for Tungstic Acid	205.60 per ton
23%	46.8c. per lb. for Tungstic Acid	215.40 per ton
24%	46.9c. per lb. for Tungstic Acid	225.20 per ton
25%	47.0c. per lb. for Tungstic Acid	235.00 per ton
26%	47.0c. per lb. for Tungstic Acid	244.80 per ton
27%	47.1c. per lb. for Tungstic Acid	254.60 per ton
28%	47.2c. per lb. for Tungstic Acid	264.40 per ton
29%	47.2c. per lb. for Tungstic Acid	274.20 per ton
30%	47.3c. per lb. for Tungstic Acid	284.00 per ton
31%	47.4c. per lb. for Tungstic Acid	$293.80 per ton
32%	47.4c. per lb. for Tungstic Acid	303.60 per ton
33%	47.4c. per lb. for Tungstic Acid	313.40 per ton
34%	47.5c. per lb. for Tungstic Acid	323.20 per ton
35%	47.6c. per lb. for Tungstic Acid	333.00 per ton
36%	47.6c. per lb. for Tungstic Acid	342.80 per ton
37%	47.6c. per lb. for Tungstic Acid	352.60 per ton
38%	47.6c. per lb. for Tungstic Acid	362.40 per ton
39%	47.7c. per lb. for Tungstic Acid	372.20 per ton
40%	47.7c. per lb. for Tungstic Acid	382.00 per ton
41%	51.2c. per lb. for Tungstic Acid	420.25 per ton
42%	52.5c. per lb. for Tungstic Acid	441.00 per ton
43%	53.7c. per lb. for Tungstic Acid	462.25 per ton
44%	55.0c. per lb. for Tungstic Acid	484.00 per ton
45%	56.1c. per lb. for Tungstic Acid	506.25 per ton
46%	57.5c. per lb. for Tungstic Acid	529.00 per ton
47%	58.7c. per lb. for Tungstic Acid	552.25 per ton
48%	60.0c. per lb. for Tungstic Acid	576.00 per ton
49%	61.2c. per lb. for Tungstic Acid	600.25 per ton
50%	62.5c. per lb. for Tungstic Acid	625.00 per ton
51%	63.7c. per lb. for Tungstic Acid	650.00 per ton
52%	65.0c. per lb. for Tungstic Acid	676 00 per ton
53%	66.5c. per lb. for Tungstic Acid	702.25 per ton
54%	67.5c. per lb. for Tungstic Acid	729.00 per ton
55%	67.5c. per lb. for Tungstic Acid	756.00 per ton
56%	70.0c. per lb. for Tungstic Acid	784.00 per ton
57%	71.6c. per lb. for Tungstic Acid	812.25 per ton
58%	72.4c. per lb. for Tungstic Acid	841 00 per ton
59%	73.7c. per lb. for Tungstic Acid	870.00 per ton
60%	75.0c. per lb. for Tungstic Acid	900.00 per ton

the latter seem to be the favorite. The tungsten concentrates produced may assay from 40 to 65% tungstic acid, 26 to 35% iron oxide, 1 to 3% manganese oxide and from 8 to 20% silica. The accompanying flow sheet illustrates typical current practice. The process is usually dry up to the first trommel or revolving screen and is wet from that point. The concentrates are dried over a fire and sacked. Most of the sampling is done by hand on account of the small size of the average shipment.

The various mills near Nederland have the following capacities: The Primos mill treats 30 tons per day, carrying from 3 to 5% WO_3; the Ardourell mill has a capacity of 25 tons and is treating 1½% material; the Wolf Tongue mill handles from 15 to 20 tons of 3½ to 4% ore per day; the Clark mill treats 12 to 20 tons per day, ranging from 3 to 5% WO_3. It is estimated that the districts' daily production of WO_3 ranges from 20 to 30 tons.

The general feeling in the district regarding the future development and prices to be received for the product is optimistic. It is the belief among operators that the veins will prove productive to considerable depth below the average now represented by the bulk of the present shafts. The prophecy regarding the market for tungsten is that the price will settle down to a firm figure and eventually not fluctuate far from present prices. There is a suggestion that a protective tariff on tungsten should be considered to favor the producers of this metal in the United States.

American Demand for Japanese Zinc Dust Growing

There is a growing demand in the United States for Japanese zinc dust. It has been developing for several years, but has increased considerably since the outbreak of the war, probably because other sources of supply have been cut off says a recent consular letter in *Commerce Reports,* June 24, 1916.

About 600 tons of zinc dust from the Nagasaki district is sent yearly to the United States. The greater part of this is purchased by New York and San Francisco importers. There is already a large zinc-smelting plant in connection with the Miike mines in the Nagasaki district. It is estimated that the yearly production of spelter is about 10,000 tons; plant increases are planned to bring the yearly output up to 15,000 tons by the end of 1916. Although there is a demand for zinc oxide and zinc sulphide, there is no production of these at the Miike mines at present. Inquiries with regard to these products have been received from the United States, and it is possible that their manufacture will be undertaken later.

Lead Plating Replaces Nickel

In the effort to cheapen storage-battery parts by reducing the cost of their plating, the invention of a lead-plating process resulted. The inventor is J. E. Schmotzer, vice-president and manager of the U. S. Electro Lead Plating Co., 1265 West Second St., Cleveland, Ohio.

The method of electrolytic lead plating used by this company is similar to that employed in plating with zinc, nickel or copper, says *Iron Age,* June 22, except that pure lead is used for plating purposes and different chemicals are used in forming the plating solution. This part of the process is secret, but a patent has been applied for.

The Willard Storage Battery Co., of Cleveland, has equipped a large plating plant in which the new process is used for plating gray- and malleable-iron castings and steel stampings. From 15,000 to 20,000 parts are lead-plated every day, these being used for battery handles, screws, top connections and terminals.

Floating Oxidized Ores*

Considerable work on the flotation of oxidized ores has been done by the Salt Lake Station of the Bureau of Mines in coöperation with the metallurgical department of the University of Utah. An article on the subject has been written by O. C. Ralston and Glen L. Allen, and issued by the Bureau of Mines. Attention is called to the fact that most of the experimental work has been done on oxidized ores of lead, because little success has been had with zinc ores, and many others are engaged in working on copper ores.

The successful flotation of oxidized mineral depends, in the opinion of the operators, upon its preliminary sulphidizing, in order to convert at least the surface of the mineral particles to sulphide form. This step is then followed by flotation just as is practiced on the natural sulphide ores. The sulphidizing methods investigated have been that by the use of hydrogen sulphide on either dry or wet ore; by the use of various sulphide solutions and sulpho compounds of sodium; by the use of solutions of the various sulphides and sulpho compounds of calcium; by the use of sulphur vapor; by the use of a sulphureted oil, and with colloidal sulphur. It was found that some of these methods formed a sulphide film on the surface of the particles of such minerals as lead carbonate or copper carbonate, whereas in other cases the mineral particles are sulphidized all the way through.

The methods have been tried on a large number of lead-carbonate ores. Some contain silver and some lead as the principal metal. Many ores have been successfully concentrated, while others refused to yield to flotation concentration. In general, a high alumina content (acid soluble) seems to prevent sulphidizing and flotation. It was found that the best method of applying hydrogen-sulphide gas to dry powdered ore was in a tumbling barrel with a gas inlet in the end. Sulphidizing in a glass bottle showed that the ore blackened quickly after the application of the gas. On attempting to float the lead sulphide as soon as it was blackened, it was found that a low extraction was obtained and also low-grade concentrates unless the pulp was previously acidified with sulphuric acid. By acidifying the pulp, cleaner concentrates were secured, but extractions of lead still remained low. Only by prolonged treatment with hydrogen sulphide gas could the extraction of lead be raised to commercial grade. With a number of ores 8 hr. treatment gave an extraction of over 80% of the lead.

Hydrogen sulphide was considered because it can be cheaply generated. With iron matte available at $5 to $10 per ton and sulphuric acid at about the same price, the cost of the hydrogen sulphide resulting, including all operations, is between $30 and $50 per ton. If this gas in combining with the metal in the ore produces only a superficial film of sulphide, it might be possible to make a ton of gas sulphidize many tons of ore. It was found,

*Excerpts from an article by O. C. Ralston and Glen L. Allen, issued by the United States Bureau of Mines.

however, that the gas attacked the ore with such avidity that by the time the latter was sulphidized sufficiently to permit of good extraction by flotation, it had been sulphidized all through, and practically a chemical equivalent of hydrogen sulphide to the lead in the ore had been absorbed. Application of hydrogen sulphide to the ground ore suspended in water does not seem to be subject to the same difficulty. Filming of the particles seems to take place, and the extractions after a short treatment with the gas are satisfactory.

The best results on lead-carbonate ores were obtained when sodium sulphide was used for the sulphidizing agent. Sodium sulphide has to be introduced in solution and seems to cause true filming. The sulphides of sodium considered commercially applicable are the normal sulphides, Na_2S; sodium polysulphides, Na_2S_4, and Na_2S_5, and the sulphhydrate of sodium, NaSH. The last seems to be quite effective. The normal sulphide is almost as effective, while the polysulphides are the least active. Different ores require from 10 min. to 24 hr. of contact with the sulphide solutions used, depending on the characters of the ore and the substance of the solution. Sodium sulphide varying from 10 to 20 lb. per ton of ore is usually sufficient and should be applied to pulp containing about one ton of water per ton of ore, in order that the solution may be as strong as possible during the sulphidizing stage of the process. After a good black color has developed and the color has ceased to increase in blackness, the pulp is diluted with water to 3:1 or 4:1, and floated. The market for sodium sulphide is limited, and it should be obtainable for less than 2c. per lb., making a process economical enough for commercial purposes.

The polysulphide of calcium, obtained by boiling powdered sulphur with slacked lime, is satisfactory for ores that yield easily to sulphidizing, but is sluggish in action as compared with the sulphides of sodium. Sulphidizing with sulphur vapor has been tried with little success, for the reason that it must be applied at a temperature above the boiling point of sulphur in order to prevent condensation. This means that a temperature of over 445° C. must be reached. The use of a sulphureted flotation oil, in which loosely combined sulphur is available for combination with carbonates of lead or other metals, and the rest of the oil is then available for oiling the artificial sulphide, has given but little encouragement. Colloidal sulphur, mentioned as a possible method of sulphidizing, does not seem to combine with lead carbonate at all. It floats as a white lining of air bubbles in the flotation machine and brings up very little lead with it.

The Course of the Precious Metals

Usually the precious metals contained in a lead-carbonate ore accompany the lead. It has been noticed that the silver extraction will lag behind the lead extraction when the ore is sulphidized with sodium sulphide and that the reverse has usually been true when hydrogen sulphide was used. The importance of sulphidizing flotation is due to the fact that there are many deposits of lead-carbonate ore in the Western States, and many of these ores have been milled with varying success. Frequently lead carbonates can be satisfactorily concentrated by gravity methods, but often it is found that particles of lead carbonates go into the slime and are lost. Tailings containing 5 to 10% of lead are common, and the object of the investigation was to determine whether sulphidizing flotation could be applied to the treatment of these deposits, and also to prevent the waste that now takes place when they are treated by gravity concentration. It would also, if successful, render amenable to treatment carbonate ores that are too low in grade to be handled by present methods. A flotation plant to apply sulphidizing flotation to an ore containing lead, silver and gold is being constructed by the Prince Consolidated Mining Co., at Pioche, Nev., for the treatment of two tailings dumps from former pan amalgamation and cyanide operations in that vicinity. It was expected that the plant would be in operation by July 1 of this year.

Tests on Copper and Zinc Ores

A few tests were made on oxidized copper ores, and hydrogen sulphide seems to be the best medium for sulphidizing these particles. When applied to the dry ore, the sulphur permeates the particles as it did in the lead ores. Applied to the wet pulp, the hydrogen sulphide seems to cause true filming. Usually black concentrates are yielded, but J. M. Callow, of the General Engineering Co., announced that that company has been able to reduce the amount of sulphur used to a point where the froth is green with slightly coated malachite. He has used as little as ½ lb. of sulphur per ton of ore, and that is giving good extraction in the plant of the Magma Copper Co., at Magma, Ariz., where his company has put in a successful installation. Sodium sulphide has been tested by a number of large companies where some little oxidized copper occurs in the sulphide ores. In this case only 2 or 3 lb. of sodium sulphide per ton of ore is used. This is easily added to the machines during flotation or to the mixing tanks before flotation. The experience is that if some little time of preliminary contact is allowed before flotation is attempted, better sulphidizing of the material will result. Calcium polysulphide has been used for some time in a number of large copper mills with indifferent success and seems to be detrimental in some instances. On some of the ores tested fair results were obtained if the calcium polysulphide was allowed to act until the ore had become well blackened. Sulphur vapor is also said to give good results in some cases. Sulphureted oils are being used also, but considerable secrecy is observed as to technical details of the work. Colloidal sulphur does not assist, so far as is known, in the flotation of oxidized copper. Attempts to float the natural sulphides along with sulphidized minerals have usually failed, since the sulphidizing agents cause trouble with the flotation of natural sulphides. At one plant this difficulty has been solved, although the details are not available.

Attempts to float oxidized particles of zinc from ores, both before and after sulphidizing by most of the methods that have been mentioned, have met with no success whatever in the laboratory experiments carried out. Possibly the fact that most of the carbonate ores of zinc contain important amounts of the silicate may be one of the reasons for the lack of success with this work.

Steel Barges to Be Used on a large scale in the river coal trade of the Pittsburgh district. The American Bridge Co., Pittsburgh, has received a contract from the Carnegie Steel Co. for 70 steel barges to be used by the latter company in transporting coal from its mines on the Monongahela River to its byproduct coke ovens now being build at Clairton. Each barge will be 175 ft. long and will carry 900 tons of coal on an 8-ft. draft of water.

Operating a Small Copper Blast Furnace

By A. Bregman*

SYNOPSIS—Some details of furnace operation and a discussion of the difficulties that arose in connection with the running of a small copper blast furnace in southwestern Colorado.

Of all the appliances known to metallurgy, perhaps the trickiest, most unstable and hardest to manage is the small blast furnace. The troubles of the operator are much reduced if all conditions are correct, but in most cases conditions are anything but correct. In fact, it is usually only in large plants, such as Anaconda and others, that the necessary preparation can be made to have all the facilities and fluxes desired, and of course even there mishaps occur. In small plants it is an almost constant fight to keep the furnace going, in the face of accidents and adverse conditions that arise in the delivery of the ores and fluxes required.

In a general way the difficulties that a typical small plant must surmount are lack of correct ores and lack of proper machinery and tools. I shall recount some of the troubles that arose in connection with the operation of a small blast furnace in Colorado and tell how some of the difficulties were overcome. To old furnacemen these matters will be trite, but to those who have not had so much experience the details of the operating difficulties encountered may be of interest.

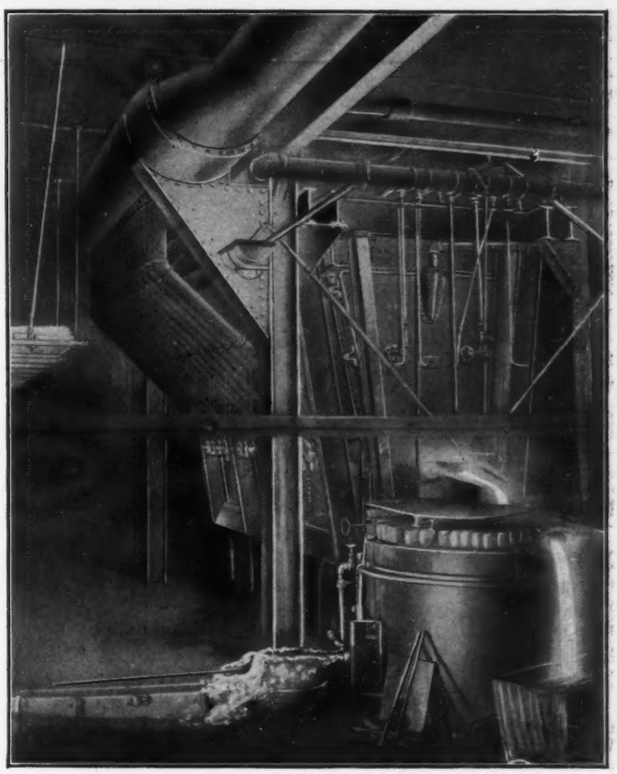
Necessity of Securing Suitable Ores

The business of getting correct ores for the smelting furnace is as important as any branch of the work. For example, "dirty" silica—silica already combined with other substances as amphibole and enstatite—does not increase the concentrating power of the furnace and at the same time is hard to melt and helps to form large crusts on the jacket. Another difficult material is magnetite, one of the hardest known ores to smelt, which often has to be run through the furnace on account of associated metals.

Lack of clean silica (quartz, quartzite, etc.) and of suitable iron ore are both serious drawbacks in the operation of the blast furnace, either large or small. The concentrating power of the furnace plays a large part on the cost sheet. The furnace must be run on the ragged edge of freezing, and usually extra iron ore is necessary if the furnace should begin to freeze. In order to run economically, a balance must be struck that will show the greatest possible earnings with the least possible "grief" to the men. Naturally when any concessions have to be made, it is the men who make them—until the trouble becomes unbearable, when conditions must be eased a little or a new crew will have to be provided. It is usually necessary that the small plant shall work under difficulties that are almost intolerable, in order to show dividends. Some of these difficulties, classified according to the part of the plant in which they occur, will be enumerated.

The combined silicas, as already stated, are difficult to smelt, and in our furnace a great deal of trouble was experienced with the formation of crusts of all sizes. Once or twice they were so large that men got into the furnace to shovel loose dirt off the crusts into the zone of the furnace that was smelting. A fairly common way to remove large crusts (too large for an ordinary bar) was to jerk them loose with a long steel hooked bar, coupled with a block and tackle. Crusts of large size were removed in this way, the flexibility of the ropes preventing any serious jarring or twisting of the plates and seams of the jackets.

The light sheet-steel charging plates of the furnace gave much trouble to the feeders by curling up and interfering with their shoveling. The edge of the heavy cast-iron dumping plate was finally placed over the flattened steel charging plate and no more trouble from buckling ensued.



COPPER BLAST FURNACE WITH CIRCULAR SETTLER

The furnace downtake was built with a sharp 90° elbow and gave great trouble because flue dust collected in the elbow until the draft was impeded and gas and smoke issued from the furnace feed doors. The sharp 90° turn blocked the draft sufficiently to permit the partly molten particles of flue dust to strike the brick lining of the downtake and stick to it. Finally, the passage through the elbow became so small that almost all the gas came out of the feed door, making it impossible for the men to work around the furnace. The plant then had to be shut down and the elbow cleaned out. This happened at regular intervals. The downtake shown in Fig. 2

*101 West 60th St., New York.

gave no trouble at all in this respect, because a long elbow was used and there was almost no choking of the draft. In regard to the lining of the downtake, it was found that no bricks were necessary above the hood proper when the downtake was correctly designed.

Keep the Taphole in Good Condition

The tapping end of the furnace should be kept in as good condition as possible—that is, free from crusts, as they can easily spread to the taphole and stop the furnace. Magnetite was especially troublesome in this way. The magnetite also increases greatly the specific gravity of the slag, making the settling of the matte imperfect. There was one stretch of a week when all the matte made at the plant in question had to be resmelted because it was so badly mixed with slag.

At one time there was no ore in the bins except a highly siliceous material running 30% copper. The crew endeavored to keep the furnace going, but it got steadily worse, ceased concentrating and the matte came down in amounts that frightened the tapper. The furnace finally had to be shut down until more suitable ore arrived.

At this plant a simple way to tell whether the furnace was concentrating properly or not was by the smoke that issued from the stack. Thick, heavy smoke right at the

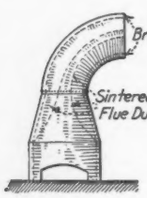


Fig. 1

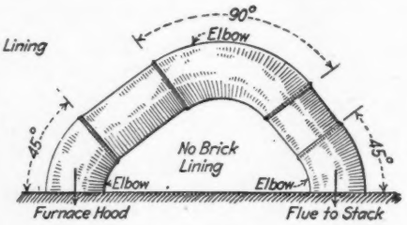


Fig. 2

mouth of the stack indicated a great deal of sulphur, hence the chances were that with so much issuing unoxidized, the furnace also contained much sulphur and consequently a heavy matte fall. Thin smoke on the other hand indicated a large percentage of SO_2; with the sulphur so largely oxidized, the matte fall was lighter. These indicators were not based on experiment, but were fairly well checked by the running of the furnace as observed below.

On the 200-ton furnace (38x180 in.) it was found that 200 gal. per min. of water was more than enough under ordinary conditions. During the blowing in, however, when the fire was right against the jackets, all the water was needed, but at other times the intervening crusts kept the jackets cool.

Some Defects of the Furnace Design

The overflow launders on the furnace in question were in a bad position. The tuyeres were 12 in. center to center, and when the jacket water got hot and began to steam, it was impossible to see from below just which jacket was getting too hot. Every two or three hours the furnaceman would feel the water from all the discharge pipes from the hanging platform for that purpose, in order to be sure of the condition of the jackets, but this was not a convenient arrangement. The overflow launders should be placed two or three feet outside the tuyeres.

The I-beam buckstays at the sides of the furnace were placed between the jackets. The only disadvantage of this arrangement was that when breakouts occurred at the seam the buckstays interfered with any efforts to stop them. A horizontal girdle would have been better.

The jackets were so designed that the drain valves were directly under the tuyeres. When these tuyeres slagged, the valve handles were burnt off. As the valves were seldom used, the handles were not replaced, but were turned with a small wrench. The drain valves, however, should have been placed about 6 in. to the right or left. The edges of all jackets should have countersunk rivets on the faces that meet each other. This is especially true of the back-end jackets, as the lower one is removed to facilitate cleaning out the furnace during a shutdown. Raised rivet heads cause a great deal of unnecessary labor in connection with the removal and replacement of the jackets.

Start Fire at Base of Stack When Blowing In

When blowing in the furnace, it was found best to light a wood fire at the base of the stack just before touching off the wood fire in the furnace itself. This stimulated the draft at the beginning, and once smoke was visible at the top of the stack, there was no difficulty with the draft in the furnace or flues.

In the small plant the furnace taphole is a place that must be watched constantly; the irregularity in the sup-

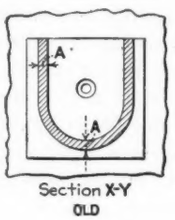
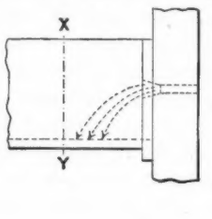


Fig. 3



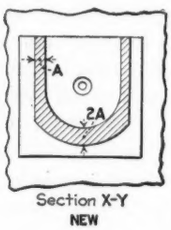


Fig. 4

ply of ore and the more delicate weighing required for the small furnace make this point insistent. "Rodding the connection," on the other hand, is only an occasional operation at most plants where large-sized furnaces and a fair amount of coke are used, there being usually a sufficient excess of heat to keep the connection free, unless a zinky or high-lime charge is being smelted. If the matte fall be normal, the taphole of even the small furnace will remain wide open and the old tapper can usually tell whether the taphole is free or not. However, it usually pays to run a rod into the furnace every hour or so to be reassured on this point. When the matte fall is light or when the furnace is running badly, the connection must be watched with the greatest vigilance, but care should be taken not to run the rod into the furnace too frequently or to leave it in the hole more than a second or two, as it may chill the slag so quickly that the hole will be closed entirely.

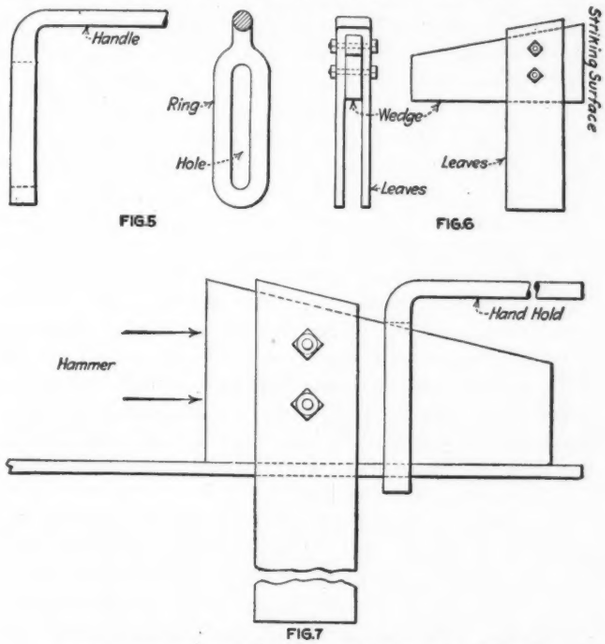
I might relate one instance illustrative of this point. The furnace was to all appearances running fairly satisfactorily, but the concentration was so high that little matte was being made. Before it was realized, the taphole had closed. The furnace had to be banked and the hole dug out before operations could be resumed. At another time the furnace seemed to be entirely normal, but the taphole kept growing smaller and smaller, for no apparent reason. Among other expedients that were tried was a decrease in the lime rock on the charge. In about two hours the hole was thawed out to its correct proportion. The high-lime slag had chilled so quickly that even

the matte could not keep the taphole open; as soon as the lime was reduced the slag remained fluid.

The spout that was supplied with the furnace was merely a cast-iron shell with no water cooling. It was lined entirely with brick, even at the nose. Numerous breakouts occurred, however, and the nose had to be replaced frequently, so that finally a water-jacketed nose was put on and there was no more trouble.

Sometimes, owing to low heat or high silica, the slags would become thick and refuse to run. This happened once just as the furnace was being tapped out through the side, with the air off, in order to bank it for a short time. It became necessary, however, to turn the blast on again and blow the slag out through the side. Of course the blast made more slag, but as soon as the matte began to come more freely, the slag became more fluid and the furnace was drained nicely.

Where pyritic or semipyritic smelting is being done, the settler and the matte-tapping block must be carefully



RING AND WEDGE—NOTE LEAVES ON WEDGE

watched. There are numerous appliances for safeguarding the tapping operations, but only a few of them will be mentioned here. The matte launder first used is shown in Fig. 3. There was always trouble with this launder because it would burn out so quickly where the matte first struck it on issuing from the settler. This was remedied by changing the design of the spout (see Fig. 4).

The ring and wedge for pulling out the tapping bar offer some opportunity for comment, as the ring often supplied is practically circular and has no handle. The ring shown in Fig. 5 has a long and narrow opening, which permits the use of a much larger wedge (see Fig. 6) and makes a better mark for the hammerman. The leaves bolted to the wedge (Fig. 6) are for the purpose of keeping it from twisting sideways on the bar. Although this may seem to be making unnecessary additions to a simple contrivance, yet it was found to be a great help, as it made sure that there would be no interruptions in drawing out the bar, thus avoiding much trouble and possible loss of the taphole.

At the plant in question endless trouble was experienced on account of the tapping block, both by reason of its shape and the material of which it was made. The hole was at first small, but naturally became larger as the matte attacked it. Numerous types were tried, and although there was not much difference, the cast-iron block shown in Fig. 8 was most used, as it best fitted the clay plugs used for stopping the flow of matte.

At first solid iron blocks with a coil of pipe cast around the hole were used. They were not satisfactory. The hole burned out to a larger size, and the matte entered the coil, stopping the flow of water. Also, the shape of the hole caused trouble because of difficulty in shutting off the matte. Once a copper block was used, but only once. The matte, which was high in iron, simply ate up the copper and a wild runaway resulted. Finally a cast-iron block with no water coil was adopted.

Procedure When Taphole Became Enlarged

So long as the hole remained small there was no trouble; when the hole grew too large, it was filled with clay and the following procedure resorted to for each tap: (1) Dig a circular trench around the tapping bar about an inch wide and as deep as possible without risking a breakout. (2) Fill in with fresh, soft clay; tamp hard; smooth off face of the hole carefully. (3) Pull out bar with ring and wedge; let matte run until enough has been obtained. (4) Plug with soft clay at the end of the dolly bar. (5) Drive tapping bar in quickly but carefully, to avoid a breakout. Steps 1 and 2 were taken in order to give the matte the inner surface of a ring of cold, damp clay to work against. Without this cold ring the matte would have burned out the dry clay in a short time, and the hole become so large that stopping the flow would have been impossible. Steps 3, 4 and 5 are ordinary procedure. This method was one which required extreme care and skill in handling the tools, but it was the only safe thing that could be done. The matte was low in copper and high in iron, which meant trouble all along from the furnace spout to the matte-casting pans; but the ore would not allow a matte of any other composition.

When the matte was hot there was great danger of its breaking out. Once it was necessary to replace the tapping block at such a time. The bar was withdrawn carefully and the matte quickly shut off before much ran out. The bar was not replaced. Then a mud dam was placed in the launder and a pool of water kept next to the plugged hole (see Fig. 10). This cooled the tapping block to such an extent that the mud could be chipped out of the taphole with safety, and water was allowed to run back into the hole. As fast as was safe the hole was dug out until the water had solidified the settler contents about an inch or two back of the block. The dam and the water were removed and the block carefully taken out. The surface of the settler against which the block fitted was plastered with damp asbestos pulp about ¼ to ½ in. thick. The new jacket was pressed against the asbestos and wedged in place.

When it was desired to open the hole, drilling was begun with a chisel bar and continued until the bright-red color showed, and then the matte was tapped by driving in the tapping bar and pulling it out immediately (the usual practice). After this tap, the hole was plugged and the bar replaced again in the usual manner. This

method of changing blocks is quite common in many plants, but in others is rarely resorted to on account of the charge running sufficiently cool to permit the change without the use of the water for cooling. It was often necessary to keep the cold water in the launder even when the tapping block was not going to be removed. Of course if the matte did break through, it was well to hide until the fireworks settled down.

It is essential that the face of the taphole be kept smooth and that the hole be pointed exactly right. Any little obstruction will cause an imperfect fit between the fresh-clay plug and the taphole, and consequently an escape of matte in the form of flying shots, which are both disconcerting and dangerous to the tapper; they are often the cause of runaways. If the bar be badly placed in the hole, it pays to pull it out and replace it correctly; this

FIG. 8

FIG. 9

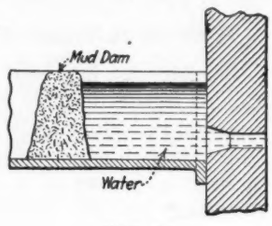


FIG. 10

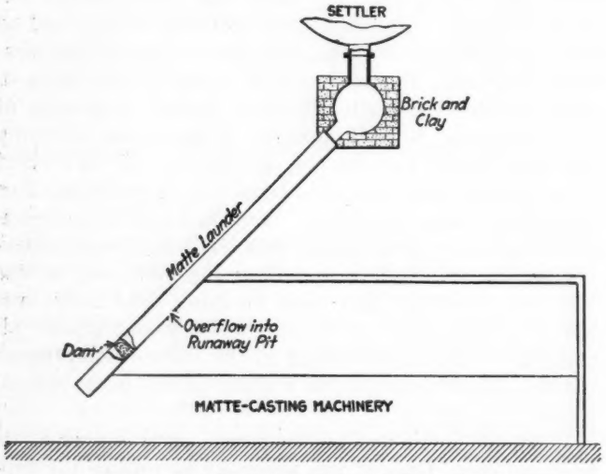


FIG. 11. MATTE-TAPPING ARRANGEMENT

can be done quite easily, because the matte is not given sufficient time to eat out the taphole to any great size.

In the settler operation it was noticed that high-iron slag and matte ate up the firebrick quickly. Magnesite brick, however, stood up well, as did also chrome brick. Conversely, high siliceous slag and high copper matte did not attack the brick nearly so much. In the settlers, water-jacketing was not used, but it could probably have been well employed with plain firebrick, under certain circumstances.

Before shutdowns, if the settler was not too hot, it was allowed to fill with matte to within a few inches of the top. The furnace was then blown out. The settler was tapped at intervals as close together as possible, care being taken to keep all holes about the settler covered so that no cold air could get in. The 2-in. layer of slag cooled sufficiently to stick about midway in the settler, and the matte drained off cleanly. When the furnace was ready to start again, all that was necessary was to punch a hole through the thin slag layer where the material overflowed from the furnace spout, and another to allow it to escape to the slag overflow. It is often a nice point of judgment as to just how long a settler can be held without draining. No rule can be set for this, as much depends on the type of slag and the amount of matte in the settler, and other factors.

The matte-casting apparatus used at this plant was a a string of rectangular dumping pans mounted on a 12-in. I-beam on trucks with 12-in wheels, having Hyatt roller bearings. The roller bearings were excellent; the machine ran smoothly and easily until a little hot matte came into contact with the wheels, when they broke as if they had been made of cast iron and struck with a hammer. They were replaced by solid wheels without special bearings, which stood the heat satisfactorily. The machine ran a little harder, of course, but if the track was kept in condition it called for no more men than before.

Matte Runaways Rendered Harmless by Diverting Matte Through Side of Launder into Pit

Owing to the arrangement of the tapping floor, it was found necessary to make an angle in the matte launder. This necessitated a bowl, or "fort," to keep the matte from eating a hole where it impinged against the side of the launder. Fig. 14 shows this fort of bricks and clay built around an old slag pot. Occasionally, in spite of everything, a runaway did occur. The first thing done was to divert the flow of matte into a pit for that purpose, by damming the launder with a large piece of solid matte (everything else would have been floated off) and chinking the crevices with clay. The launder had a semicircular piece cut out at the side facing the runaway pit; this was plugged with mud under normal conditions, but at such times the mud was knocked out and the matte flowed freely into the pit. Then, the matte-casting equipment being comparatively safe (the pit was able to take care of a full settler), the men devoted their whole attention to shutting off the matte.

It was found best to keep 5 or 6 in. of matte in the settler at all times. Less than that meant risk of freezing, and more meant too much heat and pressure during a tap. Of course the condition of the settler decided everything. The hotter the settler the less matte was stored and vice versa. The amount varied from 3 to 12 in. in a circular settler 6 ft. in diameter and 3 ft. deep.

It may be well to state in conclusion that these remarks are not intended as a general treatise on copper smelting, but merely to cite a few of the practical devices used to surmount particular difficulties. Many of the practices cited are the commonly used methods in certain plants, but at others these expedients may not be necessary. It is essential in operating a small plant to have especially competent furnacemen, and one is fortunate indeed to secure an old furnaceman who has traveled about the country considerably. The man experienced in one plant only may never have encountered many of these difficulties, and in a small plant the furnaceman is often foreman and superintendent as well.

A Tin-Concentrating and Smelting Plant for the An-Yuan mines in Hunan Province, southern China, is shortly to be placed in commission by the Wah Chang Mining and Smelting Co., which will offer this product for sale in New York, and through agencies in Europe. These mines are in the Ichang-hsien district and contain both oxide and sulphide ores in chimneys in limestone, marmorized by granite and intruded by a later granite dike along the course of which the ore chimneys are found.

Nomenclature of Mining Methods

By George J. Young*

SYNOPSIS—Classification of names of mining methods as employed by many authors and a description of different systems named by terms representing fairly common usage.

One of the important elements that contribute to the value of technical literature and description is precision in the use of terms. This subject has not received the attention it deserves. Method of mining and its equivalent term, "system of mining," have long been used and signify the different features which, taken together, characterize a given method of mining. Systematic mining is the result of evolutionary development. The cruder and simpler methods have been combined and improved, and where the various steps have been repeatedly applied in the case of a single mine, names and terms have been invented as a designation of the method. The nomenclature resulting is not based on any consistent plan, and as a result we are confronted with a large number of names and terms that are loosely used and are confusing to one who has not had actual acquaintance with mining operations. Even to the experienced individual there is often a lack of definiteness in the meaning that should be given to the names in common use.

Factors that Influence the Naming of Methods

The methods of breaking ground are briefly summarized: Drilling and blasting benches; undercutting and breaking by drilling and blasting; shearing or side cutting and breaking by drilling and blasting; top cutting and breaking by drilling and blasting; undercutting and breaking by caving; undercutting and breaking by roof pressure or by wedges; block-holing and breaking by blasting (detached masses); breaking by means of spalling hammers (detached masses).

With the exception of the term "caving" the different methods of breaking have played a subordinate part in the naming of methods. The designation caving is used with considerable looseness and has undoubtedly caused confusion in the minds of many. If the qualifying words "cover" and "ore" and the corresponding expressions "cover caving" and "ore caving" are used, much confusion will be avoided. The methods—top slicing and cover caving, top slicing with partial ore caving, block caving, chute caving—derive their names in part from the word caving to which is prefixed the descriptive word or words.

Sequence of Working, Geometric Position and Direction

The methods of working can be classified as follows:

1. Inclined orebodies are mined: (a) By successive horizontal slices from the top down; (b) by successive horizontal slices from the bottom up; (c) by successive inclined slices from the topmost corner of a block down; (d) by successive inclined slices from the lowermost corner of a block up; (e) by successive slices parallel with the end surface of a block and each slice mined from the top down; (f) by successive slices parallel with the end surface of a block and each slice mined from the bottom up.

2. Orebodies of considerable lateral extent and thickness are mined: (a) By division into blocks and panels and the working of the blocks in sequence or alternately by any of the methods already described; (b) by successive horizontal layers, beginning with the uppermost and taking the layers in sequence; (c) by caving the blocks in sequence from one end of the deposit to the other or from both ends to the center (the deposit is divided into thick layers, and the layers are worked from the top down); (d) by combination of (a) and (c).

3. Mineral deposits of great lateral extent and small thickness are mined: (a) By separate units separated by ribs of mineral left in place with subsequent working of the ribs from the boundaries of the deposit; (b) by division into panels and the working of each panel by (a), (c) or (d) of this division; (c) by successive small units that are mined in sequence from the boundaries back to the main outlet of the mine; (d) by successive small units that may be connected in a more or less continuous face that is advanced from the main working openings of the mine to the boundaries.

The terms underhand stoping, overhand stoping, top slicing, flat-back stoping, inclined-cut stoping, side stoping, rill cut, pyramidal stoping, transverse stoping, cross-stoping, etc., involve sequence, geometric position and to some extent direction. The terms block system and panel system signify the division of the deposit into large units. The terms advancing and retreating signify working out and working back, or the direction relative to the position of the main exit of the mine. The classification indicates the possibilities as well as the difficulties of using sequence, geometric position and direction as a basis for nomenclature.

The Methods of Support

Flat workings are supported: (a) Left as open chambers; (b) by pillars or ribs; (c) by rock packs; (d) by cribs (solid timber crib, open crib, rock-filled crib); (e) by props; (f) by props and head boards; (g) by props and stringers; (h) by drift sets; (i) by square-sets; (j) by waste filling.

Inclined workings are supported: (a) Left as open stopes; (b) by pillars or ribs; (c) by stulls; (d) by stulls and props; (e) by square-sets; (f) by ore filling; (g) by waste filling; (h) by stulls and waste filling; (i) by square-sets and filling.

Filling system, open stope, timbering with pigsties and filling, overhand stoping on waste, overhand stoping on ore, room-and-pillar, square-set system, square-set and fill, prop slice, etc., indicate that the method of support plays a leading part in the nomenclature used for certain methods.

The miscellaneous factors that have played a part in naming methods are: The development working, as in the case of "sublevel stoping," a miner's term—as for example, "the slash system of mining"; the name of an individual, as in the case of the "Mitchell system"; a locality, as exemplified by "the North Staffordshire system."

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A simple classification of mining methods and their important modifications is given in the following:

CLASSIFICATION

1. Underhand stoping
   - a. Open stope
   - b. Pillar-supported stope
   - c. Stull-supported stope
2. Overhand stoping
   - a. Open stope
   - b. Filled stope
     - 1. Back stope
     - 2. Transverse back stope
3. Combined overhand and underhand stope
   - a. Open stope
   - b. Pillar-supported stope
   - c. Stull-supported stope
4. Rill stoping
   - a. Open stope
   - b. Filled stope
5. Square-set stoping
   - a. Open stope
   - b. Partly filled stope
   - c. Filled stope
   - d. Vertical slice—underhand
   - e. Vertical slice—overhand
   - f. Alternate pillar and stope
6. Shrinkage stoping
   - a. Without ore passes
   - b. With ore passes
   - c. Alternate pillar and stope
7. Top slicing and cover caving
   - a. By drifts
   - b. By rooms
8. Combined top slicing and shrinkage stoping
9. Top slicing with partial ore caving
10. Block caving
11. Combined shrinkage stoping and block caving
12. Chute caving
13. Sublevel stoping
14. Longwall method
    - a. Advancing
      - 1. Without panels
      - 2. With panels
    - b. Retreating
      - 1. Without panels
      - 2. With panels
15. Room-and-pillar method
    - a. Without panels
    - b. With panels
16. Bord-and-pillar method
    - a. Without panels (obsolete)
    - b. With panels

A study of the writings[1] of many accepted authors was made, and all of the many synonymous expressions for the terms as laid down in the "Classification" have been tabulated in groups numbered consistently with the "Classification." This shows the woeful lack of uniformity in usage and the need for it in order to clarify mining texts.

SEGREGATION OF AUTHOR'S TERMS

1. Horizontal cut underhand
   Underhand quarrying of panel cores (Mitchell system)
   Underground milling
   Open-stope method
2. Stoping and filling
   Rock filling
   Filling-up method
   Method of horizontal slices in ascending order with complete filling
   Breast stoping
   Resuing
   Filling system
   Open stope, timbering with pigsties and filling
   Block system of stoping and filling
   Stoping in horizontal layers
   Slicing and filling system
   Opencut system
   Side stoping
   Longwall stoping
   Combined side and longwall stoping
   Back-filling method
   Open-stope method
   Back stoping
   Overhand stoping on waste
   Room-and-pillar with waste filling
   Dry-wall method
   Flat back stoping
   Sawtooth back stoping
   Open stope and filling
   Crosscut method of working
   Transverse with filling
   Cross stoping
   Delprat method
3. Combined stopes
   Combination stoping
   Overhand stoping and milling system
   Back and underhand stoping and milling system
4. Pyramidal stoping (?)
   Inclined cut and filling
   Rill-cut vertical stopes
   Overhand stoping in inclined floors
   Rill-cut stoping
5. Nevada system
   Square-set underhand
   Pillar and stope
   Back-filling method
   Square-set stoping
   Square-set and fill
6. Overhand stoping with shrinkage, no filling
   Overhand stoping with shrinkage and delayed filling
   Shrinkage with waste fill after ore has been removed
   Backstoping
7. Removing pillars and allowing roof to cave
   Crosscut method combined with removal of pillars
   Mining ore from top down
   Method of horizontal slices taken in descending order and allowing surface to sink
   Transverse with caving
   Top slicing and caving
   Caving system, Cumberland method of mining (?)
   Caving method, top-slicing
   Slicing under mats of timber in panels
   Square-set slicing
   Prop slicing
   Panel slicing
8. Kimberley method
9. Caving system
   Subdrifting and caving
   Caving
   Caving, subdrift method
   Subslicing, side slicing, end slicing
   Slicing under ore with back caving in rooms
   Sublevel caving
   Sublevel slicing
10. Caving system, Cumberland method of mining (?)
    Block-caving system
11. Overhand stoping with shrinkage and simultaneous caving
12. Caving by raising
    Block caving into chutes or chute caving
13. Substoping
    Sublevel backstoping
    Drift stoping
    Sublevel method
    Sublevel slicing system
    Combination of subslicing and stoping

Miscellaneous Metal-Mining Terms Not Classified

Chamber-and-pillar system
Pillars left as permanent support
Slices parallel with dip and filling
Chambers without filling
Square-set system developing into caving system
Stoping system
Filling system
Room-and-pillar system
Pillar robbing and hand filling (?)
Square work and caving
Pillar robbing
Square work and pillar robbing in conjunction with sand filling
Mitchell slicing system

14. Longwall advancing
    Longwall retreating
    Nottingham longwall or Barry system
    Working-home method
    Longwall or Shropshire method
    Longwork
    Combination longwall
15. Pillar and stall
    Post and stall
    Room and stoop (Scotland)
    Heading and stall
    Stalls and breasts
    Square work (South Staffordshire thick-seam method)
    Single-stall working
    Double-stall working
    South Staffordshire or thick-seam method
    Double-room system
    Single-entry room-and-pillar mining
    Double-entry room-and-pillar mining
    Triple-entry room-and-pillar mining
    County of Durham system, combination of the panel and room-and-pillar method
16. Following up the whole with the broken
    Bord and pillar
    System of large pillars known locally as coal gateways
    Lancashire bord-and-pillar system
    Wide or square work, modification of bord and pillar
    Narrow working
    Modified room-and-pillar working
    Room system for gaseous mines, Brown panel system for gaseous mines
    Checkerboard system (?)

Miscellaneous

Rock-chute mining
Room system with caving
Rearer method of working inclined seams
Working coal in lifts
North Staffordshire method of working rearer seams
Warwickshire method of working contiguous seams

The classification given is believed to be comprehensive and the terms fairly to represent usage. The significant features characteristic of the different methods are described in the following:

[1] J. Callon, "Lectures on Mining"; Per Larsson, "Trans. A. I. M. E.," Vol. XVI, p. 119; R. P. Rothwell, "Trans. A. I. M. E.," Vol. XVI, p. 862; John Fulton, "Trans. A. I. M. E.," Vol. XVI, p. 891; C. LeNeve Foster, "Textbook of Ore and Stone Mining"; M. C. Ihlseng, "A Manual of Mining"; Hatch and Chalmers, "Gold Mines of the Rand"; A. G. Charlton, "Gold Mining and Milling in Western Australia"; N. W. Parlee, "Mine Timbering"; Donald Clark, "Australian Mining and Metallurgy"; M. C. Ihlseng and E. B. Wilson, "A Manual of Mining"; W. H. Storms, "Timbering and Mining"; H. C. Hoover, "Principles of Mining"; L. W. Mayer, "Mining Methods in Europe"; W. R. Crane, "Ore Mining Methods"; F. W. Sperr, "L. S. M. I.," Vol. XV, p. 179, also P. S. Williams; R. B. Brinsmade, "Mining Without Timber"; D. C. Livingston, "Trans. A. I. M. E.," Vol. XLIII, p. 662; F. C. Roberts, "L. S. M. I.," Vol. XVI, p. —; F. W. Sperr, "Eng. and Min. Journ.," Vol. XCIII, p. 1181; P. B. McDonald, "M. & S. P.," Vol. CVII, p. 9; W. Bayliss, E. D. M'Neil and J. S. Lutes, "L. S. M. I.," Vol. XVIII, p. 133; C. A. Allen, "Trans. A. I. M. E.," Vol. XLIX, p. 366; P. B. Scotland, Bull. XCVIII, p. 483, A. I. M. E.; Kirby Thomas, "L. S. M. I.," Vol. X, p. —; H. W. Hughes, "A Textbook of Coal Mining"; Cockin; C. M. Bailes, "Modern Mining Practice," Vol. IV; R. S. S. Redmayne, "Modern Practice in Mining," Vol. III; "Practical Coal Mining," Vol. II, Editor W. S. Boulton; H. T. Hulst, G. R. Jackson and W. A. Siebenthal, "L. S. M. I.," 1914; O. E. Olson, O. M. Shaus and F. Blackwell, "L. S. M. I.," September, 1915.

1. UNDERHAND STOPING—This term has established itself and is consistently used. The stope may start below the floor of a level and be extended by successive horizontal slices, either worked sequentially or simultaneously in a series of steps. The modifications consist in the working of the block by a series of slices parallel with the dip, each slice being worked from the top down and the slices being taken in sequence. The stope may be left as an open stope or supported by stulls or pillars. Filling can be used after the stope has been finished or may follow the stope as a back fill.

2. OVERHAND STOPING—The broad compass of this term and the various modifications have combined to make it more of a general designation than one to which a specific meaning can be attached. It signifies the working of a block of ore from a lower level to a level above. Methods 3, 4, 5, 6, 11, 12 and 13 are important modifications of overhand stoping that have received specific names. In a restricted way overhand stoping can be applied to open or waste filled stopes that are excavated in a series of horizontal slices either sequentially or simultaneously from the bottom of a block to its top. Stull timbering or the use of pillars characterize the method. Filling is used in many instances.

3. COMBINED OVERHAND AND UNDERHAND STOPING—This term is used with a fair degree of consistency and signifies the workings of a block simultaneously from the bottom to its top and from the top to the bottom. The modifications are distinguished by the support used—open stopes, stull-supported stopes or pillar-supported stopes.

4. RILL STOPING—The term is consistently used and signifies the working of a block by a series of slices taken at an angle with the drift. The slices are taken sequentially, and a slice may be started from the top and worked down or from the bottom and worked up. It is evident that in the former case the method can be considered as a form of underhand stoping. In stepped overhand stoping there is a close approximation to rill stoping. Two modifications have been suggested in the outline-open stopes and filled stopes. In most cases where this method of mining is practiced, the filled stope is used. Support may be by stulls, stulls and filling, pillars or pillars and filling. Saw tooth stoping can be looked upon as a modification of rill stoping. In this case the stope face is formed by the simultaneous working of two sets of diagonal slices at right angles to each other.

5. SQUARE-SET STOPING—The elasticity of this method has resulted in a number of modifications which have not received a consistent nomenclature. The group term applies the use of square-set timbering as an essential feature of the method. The method is overhand stoping. The stope may be worked in horizontal slices, as a stepped face or in vertical slices. The modifications given in the outline—open stope, partly filled stope, filled stope, vertical slice (underhand), vertical slice (overhand), alternate pillar and stope—cover the more important variations.

6. SHRINKAGE STOPING—The method is a modification of overhand stoping and its characteristic is the use of a part of the ore for the purpose of support and as a working platform. As applied to small orebodies two modifications are met with—stoping without ore passes (chutes) and stoping with ore passes (surplus ore is removed by means of the ore passes). As applied to large orebodies the stopes are separated by pillars or ribs and the name used is shrinkage stoping with alternate pillar and stope.

7. TOP SLICING AND COVER CAVING—The important feature is the working of the orebody from the top down in successive horizontal slices that may follow one another sequentially or simultaneously. The whole thickness of the slice is worked. The ore may be broken by overhand or underhand stoping in each unit. The overburden or cover is caved after mining a unit. The method is a retreating method. The longwall method, the pillar robbing in both room and pillar, and bord-and-pillar methods of mining coal are essentially the same in principle as top slicing. The principal difference is that a single slice only is worked in these methods. Two modifications have been named—top slicing by drifts and top slicing by rooms. From the support used, other terms could be adopted—prop slicing, square-set slicing, drift slicing, tee-set slicing, prop-and-sill slicing. A timber mat is used in almost all cases.

8. COMBINED TOP SLICING AND SHRINKAGE STOPING—In this method the orebody is worked from the top down in successive slices. In the working of each slice the unit is worked as a shrinkage stope. The broken ore serves to give lateral support to the sides of the unit and also serves as a working platform from which the back is reached. After working a unit the cover is caved. No timber mat is used.

9. TOP SLICING COMBINED WITH ORE CAVING—In this method the orebody is worked from the top down in successive slices. Instead of taking the full height of the slice, only the lower part is taken and the upper part is caved. After removing this portion of the ore, the cover is caved. A timber mat is used in most cases to separate the broken cover from the ore and to give safety.

10. BLOCK CAVING—In this method the ore is worked from the top down in successive layers of much greater thickness than characteristic of top slicing. Each block is undercut over the greater part of its bottom area and the supporting pillars blasted out. As the block caves and settles, the cover follows. The method might be considered as involving many of the features of the preceding one, but applied on a larger scale.

11. COMBINED SHRINKAGE STOPING AND BLOCK CAVING—In this method the orebody is worked from the top down in successive layers of much greater thickness than in top slicing. The mass of ore is weakened by a series of shrinkage stopes, which are extended up between the ribs, pillars or blocks, which are subsequently caved. The intervening blocks are undercut and caved as in block caving. The cover follows the caved ore.

12. CHUTE CAVING—The method involves both overhand stoping and ore caving. The chamber is started as an overhand stope from the head of a chute and is extended up until the back weakens sufficiently to cave. The orebody is worked from the top down in thick slices, each slice being, however, attacked from the bottom and the working extending from the floor of the slice up to an intermediate point. The cover follows down upon the caved ore.

13. SUBLEVEL STOPING—This method involves features of overhand, underhand and shrinkage stoping. Its characteristic feature is the use of sublevels. The sublevels are worked simultaneously, the lowest on a given block being farthest advanced and the "subs" above following one another at short intervals. The uppermost

sublevel underneath the cover is partly caved. The caved cover follows down upon the caved ore. The broken ore is in part drawn from the level, and a part remains in the stope in order to give lateral support to the walls and to prevent admixture of cover and ore. The breaking faces are developed by crosscuts, which are extended from wall to wall from the end of the sublevel. The method can also be looked upon as a retreating method, the orebody being worked from the top down and the individual blocks upon a given level being worked from their ends to the center.

14. Longwall Method—All of the coal-mining methods overlap to a greater or less extent, and separation of the systems named in the key list is sometimes difficult. In longwall mining the distinguishing features are the winning of all of the coal on the first working, in most instances the use of top or roof pressure in mining and the caving or subsidence of the roof after the working. Unlike top slicing, the subsidence of the roof follows more or less continuously after the working of the coal. The face of coal may be continuous (straight or curved) or stepped. It may be carried at right angles to or parallel with the dip. Two important modifications are generally recognized—longwall advancing and longwall retreating.

15. Room-and-Pillar Method—The distinguishing feature is the winning of 50% or more of the coal in the first working. The coal is mined in rooms separated by narrow ribs. The coal in the ribs is won by subsequent working which may be likened to top slicing. In the rib working the roof is caved in successive blocks. The first working is an advancing and the winning of the rib coal a retreating method. The rooms are driven parallel with one another, and the room faces may be extended parallel, at right angles or at an angle to the dip.

16. Bord-and-Pillar Method—The distinguishing feature is the winning of less than 50% of coal on the first working, which in the best examples of this system is more an extension of the development work than mining. The second working is similar in principle to top slicing. The coal is won by a retreating system, the cover being caved after each unit has been worked. The two modifications given—working by the panel system and without the panel system—are more characteristic of the evolutionary development of the method than names that would characterize the present application of the system. The term "bord-and-pillar" is not used to any great extent in our own mining literature, but has a place in English literature and might well be adopted, since we have no equivalent term.

Nomenclature of Openpit Mining

The various terms that are in use to designate the winning of orebodies by surface workings are: Opencut mining, open or day workings, open work, quarrying. The term quarrying is used more or less loosely but should be confined to the winning of nonmetalliferous minerals and the excavation of dimension stone rather than to ore or coal. The following terms indicate particular methods of openpit mining: (1) Stripping system; (2) milling system, glory-hole system, chute system; (3) tunnel system.

(1) The term given here refers particularly to the removal of the overburden and is not sufficiently descriptive. I would suggest the name "terrace or bench openpit working." The method as applied consists in the removal of the ore in one or more benches, the ore face being broken by blasting and the broken ore loaded by hand, shoveling machine or steam shovel.

(2) The three names given refer to the same method. It consists of an underground system of haulageways beneath the block of ore, which has had its top surface exposed by the removal of the overburden. Connecting with the haulageways are chutes that extend up to the surface, and are spaced at intervals of 50 ft. or at any other convenient distance. The excavation of the ore begins at the top of the chute, and the broken ore is removed by loading it out from the chutes into cars on the haulage level. The ore block is worked from the top down, and the method is similar in principle to underhand stoping.

(3) In this method tunnels or drifts are extended at regular intervals from the floor of the pit into the orebody. The extension of the tunnel beyond the working face is made great enough to facilitate the handling of several cars at a time. The cars are loaded by lifting short boards which span an opening on the center line of the tunnel obtained by omitting several pieces of lagging. The top of the tunnel is protected by lagging. The method avoids the construction of raises and chutes, and facilitates the filling of the cars.

Technical mining journals and the transactions of the mining societies contribute greatly to the crystallization of the meaning to be attached to and the precise use of terms that are applicable to mining methods. While a consistent nomenclature is desirable, it is obvious that there are practical difficulties in securing short terms that will be sufficiently illuminating and comprehensive. It is suggested that writers define the terms used, and in their descriptions of methods they should describe in detail. This will lead ultimately to a standardization of mining terms simply by evolution. Such a standardization would greatly benefit the industry.

Locating Alaska Placer Claims

By A. L. H. Street*

A law enacted by the Alaska legislature in 1913 and relating to placer-mining claims provides that within 90 days from the date of discovery a locator shall record a certificate describing the location with reference to some natural object, permanent monument or well-known mining claim. It is also required that the certificate be recorded. Applying this law in the late case of Cloninger vs. Finlaison, 230 Federal Reporter, 98, the United States Circuit Court for the Ninth Circuit holds that an unverified certificate is not entitled to be recorded, that recording it confers no rights, and that a certificate describing a claim as "No. 1 Bear Creek placer mining claim" and as being situated in the While River mining district, and stating that Bear Creek is tributary to Big Eldorado, is insufficient for failing to describe the location with reasonable definiteness.

The court also applies the Federal statute which provides that no person shall locate a placer mining claim in Alaska as attorney for another unless duly authorized by written power of attorney acknowledged and recorded, by holding that such power of attorney need not be recorded before the location is made, it being sufficient that it be recorded before any adverse claim is filed.

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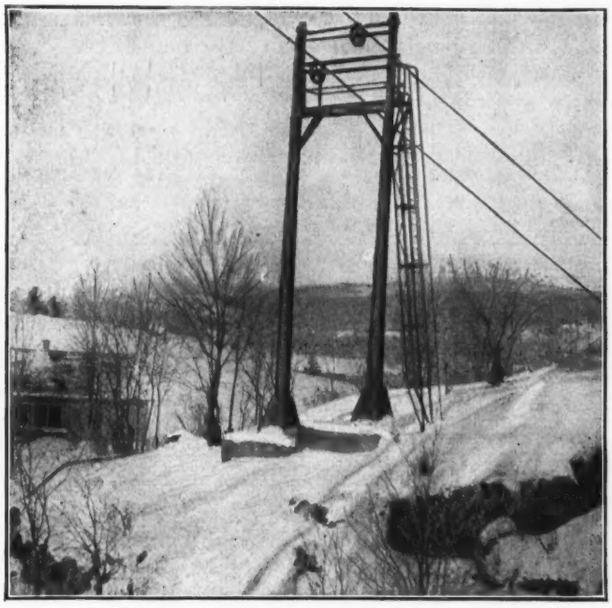
Details of Practical Mining

Concrete Idler Stands

By H. H. Hunner*

At the Isabella mine, Palmer, Mich., the Cascade Mining Co. has in use three concrete idler stands. The largest is placed on a solid-rock bluff 80 ft. from the steel idler on the shafthouse. The span between the two poles of the stand was made great enough so that by adding a third it will serve the ropes on the cage hoist. A play of 3 in. was allowed between the side of the post and the idler hub at its outer position in locating the post. On a line between centers eight anchor-bolt holes were located 1½ and 3 ft. respectively on each side of the post. On lines at 45° and 90° to the first line, 16 more holes were similarly located. A jackhamer was used



ONE OF THE CONCRETE IDLER STANDS

to drill the holes 8 in. deep. Anchor bolts made of ½-in. round with 1¼-in. eye and an 8-in. shank were next cemented into the holes facing centers.

Forms were built to the full height of the stand. Reinforcing rods were welded full length and the bottoms given approximately the correct bend before being placed in position. The corner rods were ⅞ in. square and were carried to the top of the posts. The side rods were of 1-in. square ribbed steel, ending just below the horizontal crossbrace. Horizontal ties 1x⅛ in., made to fit inside the rods, were spaced 5 ft. apart. Starting with intervals of 20 in. from the top of the beveled pier, the rods were wired horizontally, ending with intervals of 10 in. at the top. Four ¼-in. square iron rods and three horizontal ties of ⅛x1 in., 4 in. square, were used as reinforcement in the 8x8-in. horizontal brace. Eight inches back from the ends the four horizontal rods were bent down and bound to the vertical rods in the posts.

The base forms were made of 2-in. hemlock, the pier and pole forms of 1-in. hemlock. The latter were made in three sections. The bottom section was 12 ft., the middle section 10 ft. and the top section 8½ ft. long. Three sides of the forms were nailed together on the ground and then placed around the rods and the fourth side nailed on. The form was lined in with a transit and spragged securely. The reinforcing rods were first bound to the horizontal crosstie at the collar of the beveled pier only. The base forms being finished, the rock footing was washed clean and the rods spragged into position, using a transit to line up the bottom ring. The base was then poured, short lengths of rail, pieces of old cable, etc., serving as reinforcement. The forms for the beveled piers were immediately centered and filled. The mixing was all done by machine, the mixture in the base and beveled forms being 3-2-1. The same mixture was used in the poles, except that the pebbles were limited to a maximum of ¾ in.

The wiring of the rods were completed while the base was setting for two days. The lower section of the pole forms was then centered, spragged and filled. The rods cleared the inside of the forms by 1¼ in., so it was necessary to watch them closely in tamping to keep them centered. The middle section was added after allowing a few days for the setting of the bottom section. The top forms were spragged to the lower sections of the opposite form already placed and filled. The top section was handled in the same way. The holes for the bolts were left by inserting a 1-in. iron pipe in the forms just the length of the inside dimensions of the form. The brace form was set into the sides of the top forms and filled at the same time. The forms were left on for several days, and then the whole stand was allowed to set for two weeks, after which the steelwork was added. The cost was as follows:

Total labor cost (ladder included)		$356.15
2,936 lb. reinforcing steel (1 in., ⅞ in., ¾ in. and ½ in.	$46.98	
⅛-in. galvanized steel wire, 3-strand	4.00	
95 sacks cement	31.58	
Sand (cost of hauling)	27.00	
Total iron and steel (ladder included, reinforcing not included)	23.16	
Total costs		132.72
Total supplies		$488.87

The wood used in the forms was worth about $28 per 1,000 ft. b.m. new.

The Cement Gun in Mining Work

The American Zinc Co. of Tennessee purchased a cement gun to cement the bottom of a creek wherein crevices occurred which let water into the mine workings. That work has not been begun yet owing to the water in the creek being too high, but probably it will be started at an early date.

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In the meantime the gun has been used to cover many crevices in the mine where water entered during rainy periods. The procedure has been to cover a crevice with triangular mesh wire, fastened along the edge of the crevice with pieces of steel, small rocks being used inside to give backing to the gunite. Then with the gun mixture of cement and sand spread over the wire, it has resulted in making the crevice water-tight. The gun will not work against flowing water, so the crevices must be taken when they are dry.

The gun has been very useful in finishing concrete bulkheads, making them water-tight all over and especially joining them to the sides of the drifts. Also some encouraging work has been done by cementing cracks in the roof of the mine which threatened to enlarge and cause slabs to fall.

Ingenious Special Devices for Tunnel Surveys*

Interesting special devices are employed in the survey work on two new tunnels now under construction in Milwaukee, Wis. One of them is a tunnel instrument table that is easily placed, easily taken down and that, when in use, does not block the operation of the muck-cars. In connection with it are points of novelty in the tunnel marks and the way of using them. These are features of the Shore tunnel of the new Linwood Ave. intake under Lake Michigan, north of the North Point pumping station. A similar system of marks is used in the Lake St. sewer tunnel in the northern part of the city. A new thing in this tunnel is a sighting fork for giving tunnel center-line grades from the roof marks.

Handy Instrument Table

The instrument table in the Shore tunnel serves as a support for either transit or level. The timber track floor laid inside the concrete lining of the tunnel is not steady enough to permit setting the instrument tripod on it, and an extension tripod set against the tunnel ring beyond the floor would block the haulage track. The portable table was designed by Lee G. Warren, resident engineer, to meet these conditions. It is wholly above car clearance and gives rigid support on the concrete lining.

*"Engineering News," June 15, 1916.

The table, Fig. 1, consists of a 5x1¾-in. board transverse to the tunnel and somewhat shorter than its diameter, which is carried by and slides between two parallel ⅝-in. round steel bars 4½ in. apart and about 9 ft. long. Near one end each bar has a turnbuckle. By means of this the bars can be expanded or contracted to set them against the wall or release them. The ends of the bars are pointed, so that they can seat firmly in shallow pits or conical depressions chipped in the concrete wall of the tunnel. The bars extend along the sides of the table board and are held to it by metal straps and loops screwed to the board. The board is about 18 in. shorter than

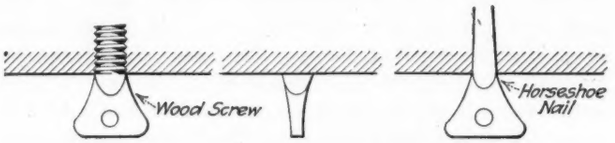


FIG. 2. NAIL OR SCREW ROOF-MARKS USED IN MILWAUKEE TUNNELS

the bars, and near one end it has a long fine-thread brass adjusting screw engaging an abutment block in the board and a nut fastened to a crossbar fixed on the side bars. By this means the table board can be shifted transverse to the tunnel axis and the instrument centered accurately on the longitudinal axis of the tunnel.

Near the middle of the board is fastened a tripod head, which is used directly to carry the level. To mount the transit, a Berger cross-slide head is screwed on the fixed head. The screw-control slide adjustment of this special head enables the instrument to be moved parallel to the tunnel axis and thus makes it possible to center the telescope directly under the point of the plumb-bob suspended from the roof marks.

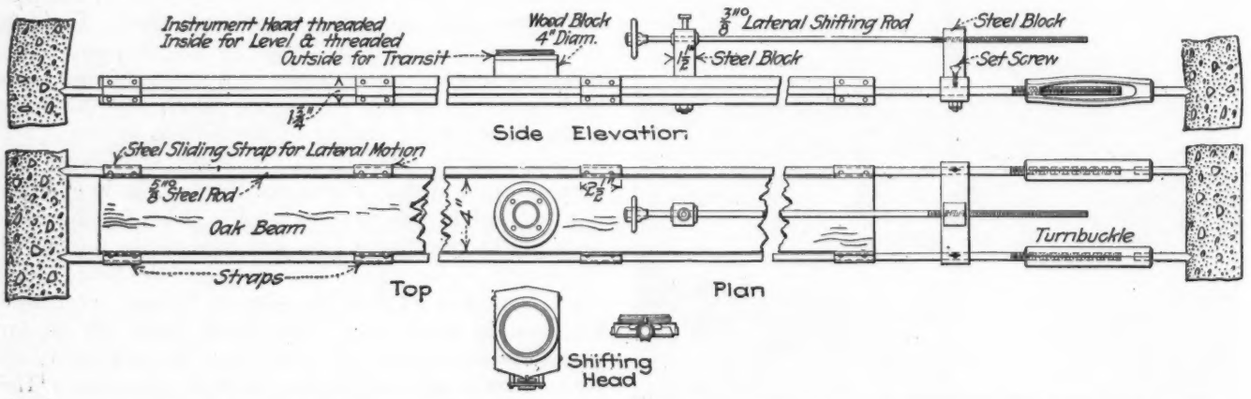


FIG. 1. QUICK-SHIFT TUNNEL INSTRUMENT TABLE USED IN LINWOOD AVE. TUNNEL, MILWAUKEE

Before setting the table in place, two keel marks are made on the side of the tunnel at the proper point, and shallow depressions are then chipped in the concrete at the marks to furnish a secure seating for the ends of the bars. Then the table is lifted up, and the bars are expanded into the depressions. The instrument is at convenient height for observing, and the clearance under the table is sufficient for the ¾-yd. tunnel cars.

As the concrete lining in this tunnel is kept close up to the excavation face, survey marks are needed in the concrete only. About every 60 ft. a short block of 2x4 is concreted in the crown of the arch flush with the under surface, and later an alignment mark is screwed into the

block. The mark is a woodscrew whose head has been forged flat and pierced with a $\frac{1}{16}$-in. hole, to serve as sighting point or to hold a plumb-bob cord. It is said to be not difficult to set these screws on center line (by transit sight) accurately enough for lining in the heading work and the forms. The two points nearest the face have plumb-bobs swung in them all the time until the next two points ahead have been set, and alignment

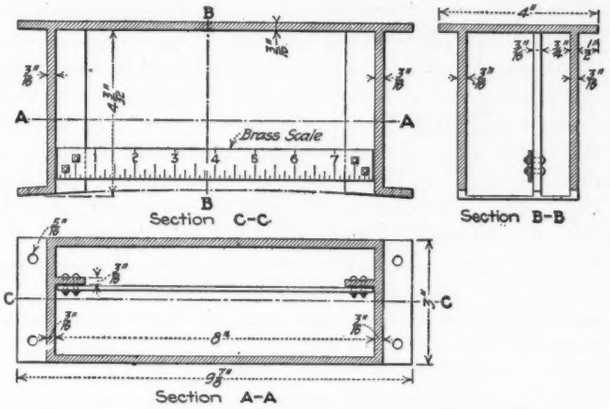


FIG. 3. SCALE ROOF-MARK USED IN LINWOOD AVE. TUNNEL

of the headings and forms forward is obtained at any time by sighting past the cords.

For lining in to grade, similar screw points are set at springing line on both sides of the tunnel barrel. Strings stretched across the tunnel between the opposite points give the means of sighting forward and lining in the front of the concreting form to correct elevation.

Permanent roof marks for the accurate prolongation of the tunnel survey are set about every 125 ft. The mark is a cast-iron box concreted in the arch flush with its under surface, with a brass scale transverse to the tunnel axis fixed permanently in this box, as shown by Fig. 3. The scale is graduated to tenths of an inch, and it is read to one-hundredths by a portable vernier plumb-bob hook, not shown in the sketch. This vernier hook is carried by the engineer and is slipped over the scale for alignment sights, the vernier reading being recorded when the plumb-bob cord is on center line.

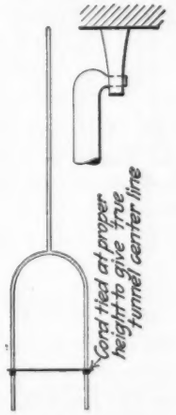


FIG. 4. GRADE-SIGHTING FORK

There is special need for accurate work in the alignment in this tunnel, because one of the shafts is driven about 30 ft. off the tunnel and reaches the tunnel by a crossdrift. Further, the tunnel makes an angle just at the point of entry of this drift; to insure correct running of the two headings from this shaft, therefore, rather accurate instrument work is required.

The permanent roof mark is also used for the definite reading of grades. Elevations are taken against the under side of the scale in the roof mark by means of an inverted level rod.

All headings of this tunnel are driven with compressed air. A roof mark is set in each air lock.

The Lake St. sewer tunnel, whose headings are worked under atmospheric pressure, has no permanent roof-mark system, but uses for both temporary and permanent service a roof mark like those employed by the inspectors in the Shore tunnel. There is a difference, however, in that the Shore tunnel roof marks are made of woodscrews with flat head, while R. H. Cahill, resident engineer of the Lake St. sewer tunnel, uses horseshoe nails with head similarly shaped and perforated.

These marks are set in pairs, 16 ft. apart along the tunnel, with an interval of 60 to 100 ft. between successive pairs. The pair nearest the heading excavation is used for sighting forward for the heading alignment and for aligning the forms. The theory of the arrangement is that it is fairly easy to sight along two strings that are only 16 ft. apart. On the other hand, it is not necessary to establish a new sighting pair every 16 ft., the interval of about 80 ft. being found very satisfactory.

For giving grade, side marks are not thought necessary, but the same roof marks are used by the help of a novel device, Fig. 4. It consists of a fork 3½ ft. long, made of light steel rod, with a hook-shaped lateral projection at the end of the straight or handle portion, this projection being about $\frac{1}{16}$ in. in diameter so as to fit into the perforation of the roof mark. When the fork hangs on the roof mark, a string stretched across the tines of the fork furnishes an excellent sighting point for grade. The string is adjusted for a given roof mark until it is just on tunnel center line, according to transit sight. The fork is then kept in just this adjustment (a record of the distance from hook to string is also noted) so long as grade sights need to be taken at this point. Hanging the proper forks at the two roof marks 16 ft. apart, a sight is taken forward over the two cords onto the front end of the concreting form until this is brought up to true tunnel grade. The headings are kept in grade and line by the foreman sighting by the marks.

Acknowledgments for information are due to the resident engineers, R. H. Cahill and Lee G. Warren, and to George F. Staal, City Engineer of Milwaukee, under whose direction both pieces of work are being done.

Ore-Breaking an Aid to Crushing

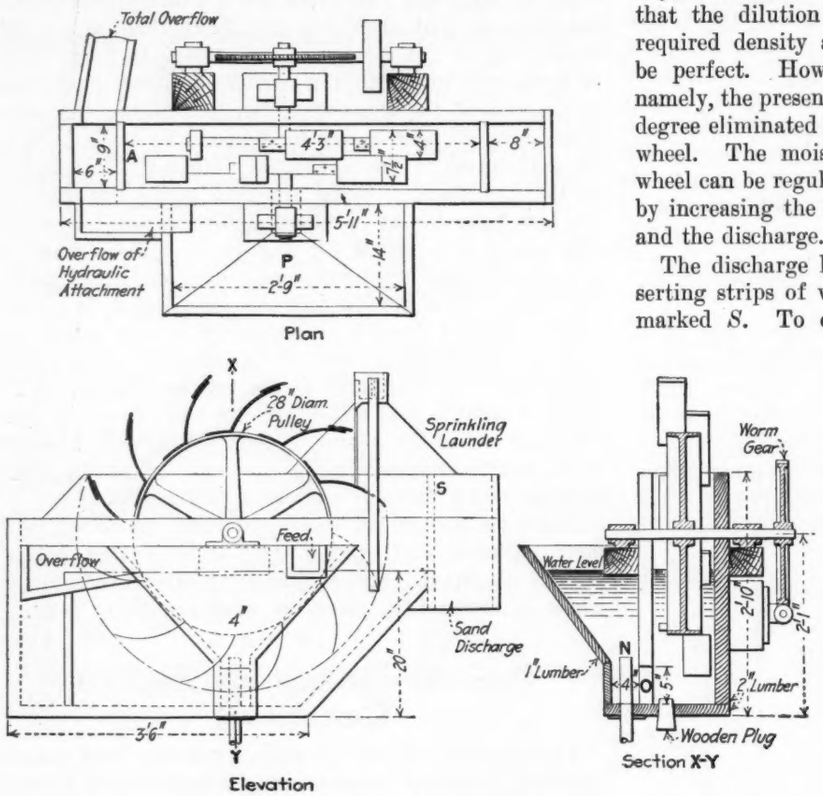
The breaking of ore in such a manner that coarse crushing is reduced to a minimum is practiced at Broken Hill, Australia. In stoping, as many holes as practicable are drilled at each set up, and these are fired by ordinary fuses cut to lengths to give the desired rotation of shots, blasting gelatin (92% nitroglycerin) being used so as to effect the maximum of shattering of the ore to save spalling.

For the same reason, says E. J. Horwood in a paper presented at the February, 1916, meeting of the A. I. M. E. in New York, simultaneous firing with electric fuses was, after making tests, found uneconomical, as the ore came down in much larger pieces, entailing added expense in "popping" and spalling. The firing of one hole at a time results in numerous cross-breaks in the ore and reduces the cost of breaking up to the size required by the mills—that is about 10 in. diameter. Another disadvantage of electric firing in stopes was that the excessive vibration set up in firing all the explosives at one time was a source of danger, as it would tend to weaken the backs of stopes and lead to accidents through falls of ground.

Details of Milling and Smelting

Combination Pulp Classifier*

The requirements of the milling practice at a Bolivian tin-concentration plant were such that neither the existing hydraulic nor mechanical classifiers completely satisfied, so a new machine was designed to do the work. As shown in the accompanying drawing, the device consists of a narrow wooden trough in which a paddlewheel revolves. Details of the construction of the classifier can



COMBINATION PULP CLASSIFIER

be easily gathered from the drawing. The tips of the blades are protected by ¼-in. iron strips fixed with two countersunk rivets. The strips last about 4 months and are replaced at small cost. The blades are cut from ¼-in. plate and bent in the fire. They are fixed to the rim of the pulley by three 1x⅜-in. machine bolts. The holes in the rim and those in the blades are bored from a templet, and spare blades are kept ready so that but little time is lost in making renewals. The wheel is driven at the rate of 3 r.p.m. by a simple worm gear—in this case taken from an old vanner—directly belted to a lineshaft. The feed is introduced into the trough near the bottom at *O*, after having been submitted to hydraulic classification in the pyramidal attachment *P*, in which an ascending current of water flows out of the pipe *N*. Consequently the material undesirable in the jig feed is floated off with the use of less hydraulic water than needed in an ordinary hindered-settling classifier because the slimes that come with the sands into the trough are separated by the paddlewheel and flow over at *A*. It is evident that classification in the hydraulic pocket does not entirely take place under hindered-settling conditions, because in that case the sand treated by the wheel could not contain any slimes. The amount of hydraulic water used is such that the dilution of the overflow does not exceed the required density and therefore the classification cannot be perfect. However, the most objectionable factor—namely, the presence of slimes in the jig feed—is to a large degree eliminated by the subsequent action of the paddlewheel. The moisture in the sands discharged by the wheel can be regulated by raising the level of discharge or by increasing the distance between the tips of the blades and the discharge.

The discharge level of the sands can be varied by inserting strips of wood of different heights into the slots marked *S*. To obtain practical results the sands are discharged at a point 1½ in. above the overflow with 50 to 55% moisture, but with the level of sands discharge raised to 2½ in. above the overflow and the discharge edge spaced from the wheel, as shown in the drawing, the product contains but 30 to 35% moisture, although under these conditions the capacity decreases out of all proportion. If the machine is overfed, the sands pile up so high at the discharge that part of them remain lying on the paddles and fall back into the trough at the other side, finally choking the classifier.

The second method gives a drier and cleaner product, because the sands are piled up in front of the wheel until they reach a sufficient height to slide over the discharge edge, and nearly all the water drains back into the trough. There is no objection to placing the overflow rim in the trough close to the paddles, which makes the machine more compact.

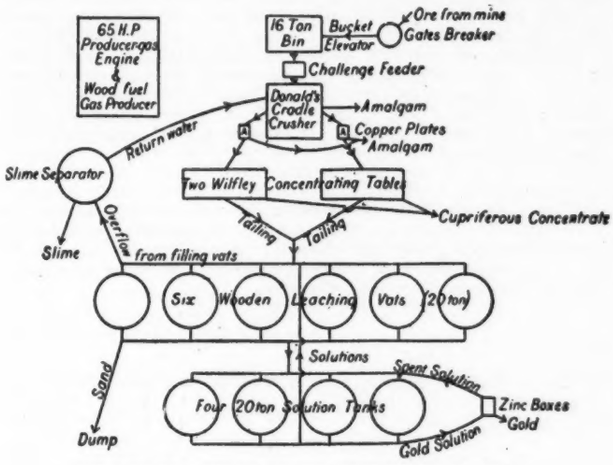
A spray is provided to remove the adhering grains of sand from the blades of the wheel, and after having cleaned the blades, the water falls on the pile of sands lying in front of the wheel and gives them a final wash. The slower the wheel revolves the cleaner will be the sands product, because then every blade brings up slightly more sands than it can deliver, and part of the material falls back into the trough to be shoved up again by the next blade. Therefore the sand is repeatedly turned over before being discharged, which materially assists in removing the slimes.

The classifier can easily handle per 24 hr. 60 tons of dry pulp with a specific gravity of 3.5 to 3.8. It satisfactorily performed the work required of it.

*Excerpt from a paper by M. G. F. Sohnlein, Machacamarca, Bolivia, to be read at the Arizona meeting, September, 1916, of the American Institute of Mining Engineers.

Donald's Cradle Crusher

At the new mill of the Queen Bee Co. of South Australia a novel fine crusher is being tried out, which is known as Donald's Cradle Crusher. It consists essentially of a semicylinder 6 ft. in diameter and about the same length, resting upon what are described as knife-edge bearings. The cylinder is oscillated at about 20 double rocks per minute. Three metal rollers, each weighing about 1½ tons, rest on renewable tracks within the periphery of the semicylinder and do the fine crushing as the cylinder oscillates. Apparently this machine embodies a modification of the tube-mill idea wherein the heavy rollers do the work of tube-mill balls or pebbles.



FLOW SHEET OF THE QUEEN BEE MILL

The flow-sheet of the mill is given on the accompanying diagram.

Inside amalgamation is practiced, and the crushed product is discharged through screens at both ends of the cylinder. It is claimed that the machine is an efficient amalgamator and that the crushed product is very free from slimes.

The divided discharge passes over small amalgamating plates and thence over Wilfley concentrators to recover the copper. Provision is made for the tailings to be run into 20-ton cyanide vats, the overflow water going to a slime separator from which it is returned to the crusher.—"Review of Mining Operations," South Australia, No. 23.

Formula for Belt Slip*

By W. F. Schaphorst

In the transmission of power by belts a certain amount of slip is inevitable. Over 2% slip indicates that there is something materially wrong and that the losses are likely to be considerable. The following formula is useful for the calculation of the percentage slip:

$$100 = \frac{100n(d + t)}{N(D + t)}$$

in which

n = R.p.m. of the driven pulley;
N = R.p.m. of the driving pulley;
d = Diameter of driven pulley in inches;
D = Diameter of driving pulley in inches;
t = Thickness of belt in inches.

*Copyright, 1916, by W. F. Schaphorst, Woolworth Building, New York City.

The application of this formula will give a factor greater than zero. If under 2%, the belt is considered to be operating satisfactorily. If over 2% the loss should be investigated. The annual cost of this excessive slip can be calculated from the following formula:

$$\textit{Cost per year in dollars} = \left[0.98 - \frac{n(d + t)}{N(D + t)}\right] PCHW$$

where

P = Hp. delivered by the engine to the driving pulley;
C = Cost in dollars of one hp.-hr.;
H = Running hours per day;
W = Working days per year.

Extraction of Gold and Silver from Matte by Lead*

In practice there are two different processes for the extraction of the noble metals from materials containing gold and silver.

1. Smelting with lead ores or lead-carrying materials in the blast furnace. The resulting base bullion is desilverized and the gold and silver parted.

2. Treatment of mattes and speises with molten lead (Crooke and Davies). The treatment of copper matte with molten lead for the removal of gold and silver is still used in Japan (Bull. A. I. M. E., Nov., 1914, p. 2693).

The results from practice show in general that the gold collects chiefly in the base bullion, the silver dividing itself between base bullion and matte. The percentage extraction of silver is lower, the greater the amount of matte for the same amount of base bullion. This fact is brought out clearly in an article by M. Ortin (Metall und Erz, 1913, p. 840).

Experimental results are given in an article by S. Blisinski (Chemik Polski, XII, 1912, No. 8). He made a series of synthetic mattes by melting together FeS (Fe = 70.25, S = 25.54 per cent.) with Cu_2S (Cu = 78.8, S = 20.98 per cent.) in such proportions, that the resulting mattes contained about 25 per cent. copper. These mattes were repeatedly remelted with powdered silver and gold. Thirty grams of this material was then melted with lead in a muffle furnace in a graphite crucible. In these tests the quantity of the lead, the temperature, and the duration of the melting were varied. In the resulting product lead, gold and silver were determined. The first series of experiments were made with mattes A and B of the following analyses:

	Ag	Cu	Fe	S
A	7.32	17.10	46.80	25.24
B	8.80	17.50	44.95	25.18

Thirty grams each of A and B were melted with 15 to 120 gr. Pb at 1,000, 1,100 and 1,250° C. for from 45 to 90 minutes.

*Translated in abstract from the Journal of the Russian Metallurgical Society, 1914, No. 4, pp. 511 to 522, and published in "Met. & Chem. Engr.," June 15, 1916.

The Use of Screw Jacks for driving lath timbers is a practice in vogue in the Proprietary and other mines at Broken Hill, Australia, says E. J. Horwood in a paper presented at the February, 1916, meeting of the A. I. M. E. in New York. Hammering not only destroys the lath before it gets home, if driving is difficult, but the vibration tends to start a run of ground.

Company Reports

The Osceola Consolidated Mining Co. of Michigan reports copper sales of 19,731,472 lb. at 18.19c., a total of $3,589,605, and miscellaneous receipts of $1,104. Mining expenses were $1,611,676; new construction, $82,074; smelting, freight, commissions, Eastern office, etc., $283,277; interest debit, $2,822; leaving a working profit of $1,610,860. Dividends of $11 per share were paid, or $1,057,650, leaving an increase in assets of $553,210 for the year, and a balance of assets of $2,166,647 at Dec. 31, 1915. Comparative results for 1914 and 1915 are as follows:

	1914	1915
Tons of rock treated	1,108,447	1,361,089
Cost of mining, milling and taxes per ton of rock	$1.29	$1.18
Pounds of mineral obtained	20,997,900	26,777,790
Pounds of refined copper produced	14,970,737	19,731,472
Per cent. of copper in mineral	71.296	73.686
Pounds copper pe. ton of rock	13.5	14.5
Cost per Pound:		
Mine expense	9.52c.	8.17c.
Construction	0.14c.	0.41c.
Smelting, etc	1.12c.	1.44c.
Interest	0.01c.	0.01c.
Total cost	10.79c.	10.03c.
Osceola Branch:		
Sinking in feet	153	0
Openings in feet	2,746	4,144
North Kearsarge Branch:		
Sinking in feet	102	173.5
Openings in feet	1,808	4,550
South Kearsarge Branch:		
Sinking in feet	0	0
Openings in feet	27	74

No. 6 shaft, Osceola branch, is now 4,734 ft. from surface; No. 1 on the North Kearsarge is 3,873.5 ft. from the surface and No. 1, South Kearsarge branch is now 2,820.5 ft. from the surface. The ore in the Osceola branch ran 14.26 lb. per ton; North Kearsarge, 12.87 lb. and South Kearsarge, 16.72 lb. per ton of rock. Costs in these three branches were 12.34c., 10.99c. and 7.77c., respectively.

In the Dome Mines report for 1915 the most interesting feature concerns the ore reserves. At the end of 1914 the reserves stood at 2,782,811 tons averaging $4.15. This figure was based on the idea of wholesale mining. During 1915 the development of much higher grade orebodies necessitated a revision of the estimates and as a consequence it was found possible to exclude a large tonnage of unpayable ore. Notwithstanding this elimination and also the production of $1,887,958, the ore reserves at the end of the year were 2,600,000 tons averaging $6.20, or a total of $16,120,000. No ore is estimated below the 7th level, nor is any account taken of intersections on the 7th level that have not yet been developed. The ore below the 7th level has been proved by diamond-drill holes. The net value of the ore reserves is approximately $22.50 a share or a total of $9,000,000.

During the year there was recovered a total of $1,887,958 from which the net proft was $912,379 as compared with $315,179 for the previous year. Total operating costs were $2.559 a ton and it is estimated that with the increased milling capacity the costs will be reduced to $2.25 a ton. The mill capacity is being brought up to 45,000 tons a month and the management is already considering plans for still further additions.

The Nova Scotia Steel and Coal Co., Ltd., reports as follows for 1915: Coke made, 90,896 tons; limestone and dolomite quarried, 79,211 tons; pig iron made, 73,110 tons; steel ingots made at Sydney mines, 97,072 tons; steel billets rolled in New Glasgow, 76,082 tons; total shipments of finished forgings, etc., from the New Glasgow plant, 60,283 tons. There were nearly 3,000,000 shrapnel and high-explosive shell bodies manufactured in 1915, chiefly 3-in. shrapnel and 4½-in. and 60-lb. high-explosive. The company is now prepared to furnish shell bodies up to 12-in. diameter. Coal mined amounted to 611,923 tons, a decrease of 140,230 tons from 1914. The company used 285,971 tons, a decrease of 110,323 tons. Iron ore mined amounted to 125,609 tons, the smallest output for many years. Nearly all was used in the company's own operations. Net profits for the year were $2,094,170, of which $36,310 was used in bond retirement, and $604,718 in paying interest on bonds and debenture stocks and all accumulated dividends to Dec. 31, 1915, leaving, with the $57,466 carried forward in profit and loss on Jan. 1, 1915, a total profit and loss balance of $1,510,609. During the year $1,000,000 in debenture stock and 15,000 shares of the ordinary stock were issued. The Eastern Car Co., Ltd., all of whose common stock is owned by the Nova Scotia Steel and Coal Co., in the year ended Nov. 30, 1915, showed a profit after writing off depreciation, betterments, etc., of $359,746, out of which it paid bond interest and all dividends on the preferred stock, and carried forward a balance of $222,546. The total capitalization of the Nova Scotia Steel and Coal Co. is now $7,500,000 of common stock, $1,000,000 preferred, $5,833,309 bonds and $4,000,000 debenture stock.

The Calumet & Hecla Mining Co., of Michigan, reports a copper production of 72,613,320 lb. of copper for 1915, of which 71,030,518 lb. was produced from the mine and 1,582,802 lb. from the sand bank at Torch Lake. Statistics of copper recovery from ore are as follows:

	1913	1914	1915
Tons of rock crushed	2,035,625	2,592,462	3,188,583
Mine cost per ton of rock, excluding construction	$2.38	$1.85	$1.71
Pounds of refined copper	45,016,890	53,691,562	71,030,518
Pounds copper per ton of rock	22.11	20.70	22.28
Cost of construction per lb., Cu.	1.54c.	1.00c.	0.47c.
Total cost per pound Cu.	14.25c.	11.35c.	9.33c.
Price received	15.77c.	14.01c.	18.11c.

From the Conglomerate lode there was 1,739,984 tons of rock treated carrying 29.74 lb. of copper per ton. Shaft sinking on this lode amounted to 201 ft. and drifting to 5,522 ft. The South Hecla Nos. 9 and 10 is now down 8,132.7 ft. On the Osceola lode 1,448,599 tons of rock was treated, carrying only 13.32 lb. of copper per ton of rock and produced at a cost of 9.71c. per lb. There was 10,206 ft. of drifting done here. No. 16 shaft is deepest, 3,274 ft. No work was done on the Kearsarge lode, on the Manitou-Frontenac Branch, or the St. Louis Branch during 1915. For recrushing coarse tailings the new pebble mill plant is far superior to the chilean mills of the old plant as shown by the following comparison:

	Old Chileans	New Pebble
Tons coarse tailings crushed	337,243	168,461
Pounds Cu per ton in tailings	13.14	13.14
Pounds Cu saved	4.01	4.73
Cost per pound, excluding smelting and selling	6.52c.	4.36c.

The Torch Lake tailings reclamation plant went into commission in a small way in June, but was interrupted by power troubles in July and August. Since September it has been running continuously. There are now 48 Hardinge mills regrinding sand-bank tailings, this will soon be increased by 16 more. The leaching plant is approaching completion and it is hoped to have it in operation early in the summer. Current assets exceed current liabilities by $8,256,446, excluding from current assets all subsidiary shares held and from current liabilities the $4,134,000 in notes due in 1919.

The Greene Cananea Copper Co., which holds 961,398 shares out of 1,000,000 of the Greene Consolidated Copper Co., reports no dividends paid in 1915, but 1% declared payable on Jan. 17, 1916. Its gross income was $550,571; its expenses, $44,532; leaving net of $506,039. The dividend referred to amounted to $488,337. The mines and works controlled by the company produced during 1915 from its own ores and those purchased a total of 16,335,081 lb. of fine copper, 635,997 oz. of silver, and 3,774 oz. of gold. The price received for its copper was 19.556c. per lb. The total cost was 11.086c., after deducting the precious-metal values and miscellaneous revenue, but including shutdown charges and general expense. **The Cananea Consolidated Copper Co.** produced 15,843,318 lb. of copper at a cost of 10.94c. per lb., and sold it for 19.541c. per lb. Operating profits were $1,362,606, from which $500,000 was paid to stockholders of the Greene Consolidated Copper Co. There was 270,584 tons of ore mined during 1915, of which 274 tons were sold to other smelters, and 79,642 tons were concentrated 3.142 to 1. Altogether the reduction works operated from

June 15 to Oct. 24, when Villa took possession of Northern Sonora, and from Dec. 10 to the end of the year (still running on May 10). A total of 312,196 tons of ore were treated, 293,663 domestic, 15,364 of foreign, and 3,169 custom. The returnable copper in foreign and custom ores was 3,087,506 lb., silver was 99,340 oz., and gold, 388 oz. About $200,000 loss was suffered through requisition of supplies, etc. **The San Pedro Copper Co.,** also owned by Greene Cananea, mined 15,574 tons of ore, of which 182 tons was sold to other smelters and 15,364 tons treated by it. Production was: Copper, 791,763 lb., silver, 18,920 oz.; and gold, 106 oz. Net income was $47,938.

The Ahmeek Mining Co. of Michigan reports as follows for the year ended Dec. 31, 1915:

	1914	1915
Tons of rock treated	590,519	948,874
Cost of mining, milling and taxes per ton of rock	$1.55	$1.26
Pounds of mineral obtained	20,333,000	32,292,325
Pounds of refined copper produced	13,634,605	21,800,492
Per cent. copper to mineral	67.06	67.50
Pounds copper per ton of rock	23.1	23.0
Mining expenses per pound copper	6.73c.	5.48c.
Construction	1.68c.	0.81c.
Smelting, freight, commissions	1.30c.	1.67c.
Total cost per pound copper	9.71c.	7.96c.

There was 175 ft. of shaft sinking and 8,419 ft. of crosscutting done in 1915. No. 2 shaft is now 2,775 ft. from the surface. A concrete foundation has been placed there for a new steel rockhouse, erection of which was begun in March, 1916. Two new stamps were installed and the regrinding plant for them finished in January. Two new stamps will be installed this year. Dividends of $18 were paid and the balance of net assets increased by $614,882, making a total at the end of the year of $1,583,654.

The Isle Royale Copper Co., operating in Michigan, reports a copper production for 1915 of 9,342,106 lb., sold at 18.36c. per lb., and silver sales of $38,974. Net profit for the year was $498,277, while net current assets increased by $214,709. Comparative figures for 1914 and 1915 are:

	1914	1915
Tons of rock treated	474,349	680,270
Mining, milling, and taxes per ton of rock	$1.49	$1.45
Pounds of mineral obtained	9,451,115	13,727,832
Pounds refined copper produced	6,601,235	9,342,106
Per cent. refined copper in mineral	69.85	68.05
Pounds copper per ton of rock	13.9	13.7
Cost per pound, mining expense	10.67c.	10.56c.
Construction	0.53c.	1.50c.
Unwatering Huron shaft	0.13c.	0.23c.
Smelting, freight, etc	1.46c.	2.06c.
Interest	0.21c.	0.22c.
Extraordinary expense	.....	1.96c.
Total cost per pound of copper	13.05c.	14.94c.

Sinking amounted to 538.5 ft. No. 2 shaft is 3,211 ft. deep. There were 14,446 ft. of openings driven, and 799,800 tons of rock hoisted, of which 15% was discarded, or 119,620 tons. The old mill was destroyed by fire on Dec. 7, 1914, on June 7, 1915, the first unit in the new mill was placed in commission, and the third on Aug. 27. New machinery for the slime copper was being put in at the time of the fire, and while the coarse jigging machinery has not been changed, Wilfley tables have been installed throughout for the finished product and for the slimes. A Hardinge mill is being erected to regrind the richer of the coarse products.

The Centennial Copper Co. of Michigan reports sale of 2,347,500 lb. of copper in 1915 at 18.145c. per lb., and an increase of quick assets for the year of $248,484, making a balance of quick assets on Dec. 31, 1915, of $273,119. Comparative results for 1914 and 1915 are as follows:

	1914	1915
Tons of rock treated	138,136	150,191
Cost of mining, milling and taxes per ton of rock	$1.838	$1.753
Pounds of mineral obtained	3,311,780	3,029,880
Refined copper produced	2,287,130	2,347,500
Per cent. copper in mineral	69.06	77.48
Pounds copper per ton of rock	16.56	15.63
Mining costs per pound of copper	11.10c.	11.21c.
Smelting, freight, commission, etc.	1.11c.	1.16c.
Interest	0.35c.	0.08c.
Total cost per pound of copper	12.56c.	12.45c.

No sinking was done during the year and 2,366 ft. of openings made. No. 2 shaft is now 4,293 ft. deep.

The Alaska Mexican Gold Mining Co., operating at Douglas Island, Alaska, for the year 1915 reports 216,428 tons crushed, giving a yield of $190,980 in free gold and 4,769 tons of concentrates from which $188,817 was recovered. The total yield was thus $379,797, or $1.75 per ton. Profits were $99,477, and $90,000 dividends were paid. Development work amounted to 2,153 ft. on the Mexican property, 354 ft. on the United property and a share of 3,696 ft. of joint work by itself, the Treadwell and United companies. Of the 216,428 tons milled, only 79,135 tons was broken during the year, 137,293 tons being drawn from stock. Ore reserves amounted to 1,188,866 tons of $1.87 tenor on Dec. 31, 1915, against 688,738 of $2.68 tenor on Dec. 31, 1914. This includes pillars. The Mexican mill crushed 214,179 tons of ore with a stamp duty of 5.24 tons. One pound of chrome-steel shoe crushed 2.48 tons of ore and 1 lb. of Treadwell die crushed 5.34 tons. Milling costs were $0.306 per ton. Sulphurets were treated at the plant owned jointly by Mexican, Treadwell and United. Crushing cost $0.040; tramming, $0.016; stamping, $0.192; concentrating, $0.058. Development costs were $14.739 per ft., stoping, $1.111 per ton; tramming, $0.151; hoisting, $0.104 per ton.

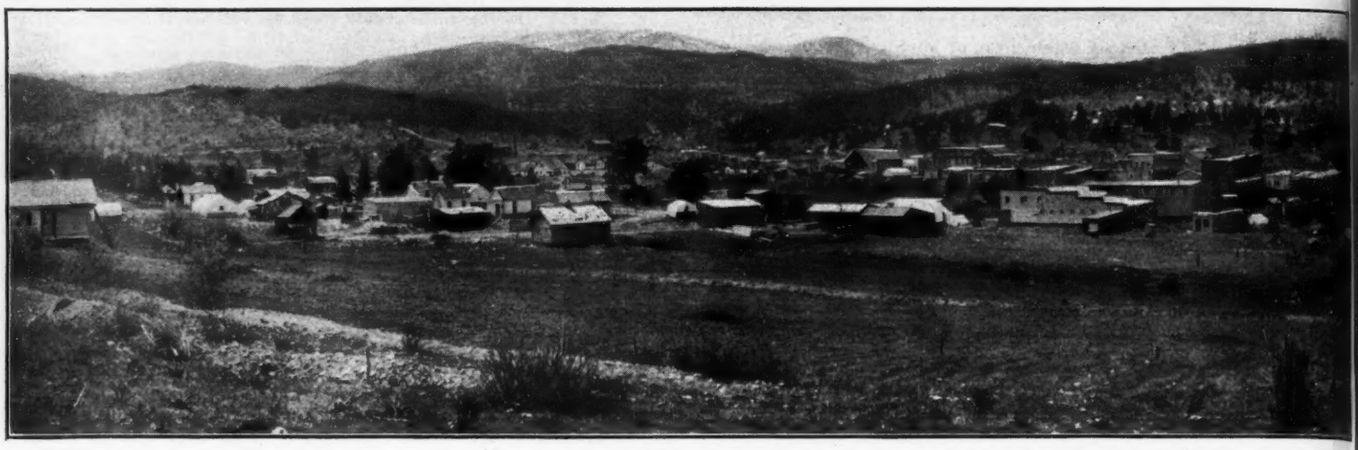
The McKinley-Darragh-Savage Mines of Cobalt, Ltd., report for the year 1915 that 1,008,383 oz. of silver was removed from the McKinley mine and dumps of which 170,236 was lost in milling and that 308,122 oz. was removed from the Savage mine and dumps of which 38,454 was lost in milling, making a total of 1,061,136 oz. recovered. Their average price received was 50.785c. per oz. and the total costs were 28.710c. per oz. Estimated ore reserves on Jan. 1, 1916, were 1,871,280 oz. of silver compared with 2,132,820 oz. of silver on Jan. 1, 1915, an estimated shrinkage of 261,540 oz. There were 63,661 tons of ore treated by the mill. The purchase of new properties was considered during the year, but none was found sufficiently attractive to warrant its purchase.

The Tonopah Extension Mining Co., of Tonopah, Nev., during the year ended Mar. 31, 1916, produced 91,981.54 dry tons of ore averaging $18.038 per ton, on which a recovery of 92.39% was made. The silver sold amounted to 2,106,518 oz. at 52.578c. per oz., and the gold amounted to 20,575 oz. Mining costs were $4.614 per ton of ore; milling, $4.478, and marketing and refining, $0.501. Profits were $584,421, of which $412,496 was declared in dividends, $63,043 was spent in new construction, $26,625 used to pay net liabilities incurred in the acquisition of the Tonopah Merger and Tonopah Victor properties, and $82,255 was carried to surplus. The capital stock of the Tonopah Extension Co. was increased during the year from 1,000,000 shares to 2,000,000 shares (par value, $1) and $329,368 of the new stock given for the Merger and Victor properties. At the same time the company acquired plant, equipment, supplies, etc., valued at $66,170, and assumed liabilities of $43,388. The present area of the Extension properties is 551.1 acres. A total of 13,967 ft. of development work was done during the year, but no attempt has been made to block out ore reserves.

The Shannon Copper Co., operating at Clifton, Ariz., reports that it operated only about seven months of the year ended Dec. 31, 1915. In that period it produced 6,017,642 lb. of copper, 35,499.63 oz. of silver and 690.417 oz. of gold. The copper sold at 17.799c. per lb. and the silver for 48.978c. per oz., making returns from metal sales $1,102,275. Operating expenses were $853,625, leaving operating profits of $248,650. To this must be added interest receipts of $16,228, while expenses during the period the company was not operating were $43,044 and the Shannon-Arizona Railway Co. had a deficit of $12,155, leaving final net profits of $209,678. The company's leaching experiments have demonstrated that the mill tailings, and possibly the low grade, semi-oxidized ores can be treated at a substantial profit, and the company has a 150-ton leaching plant under construction, which should be completed by the end of June. Current assets exceed current liabilities by $555,688, not including as an asset $381,000 of the Shannon-Arizona Railway Co.'s bonds. Only $194,000 of these bonds are now on the bands of the public.

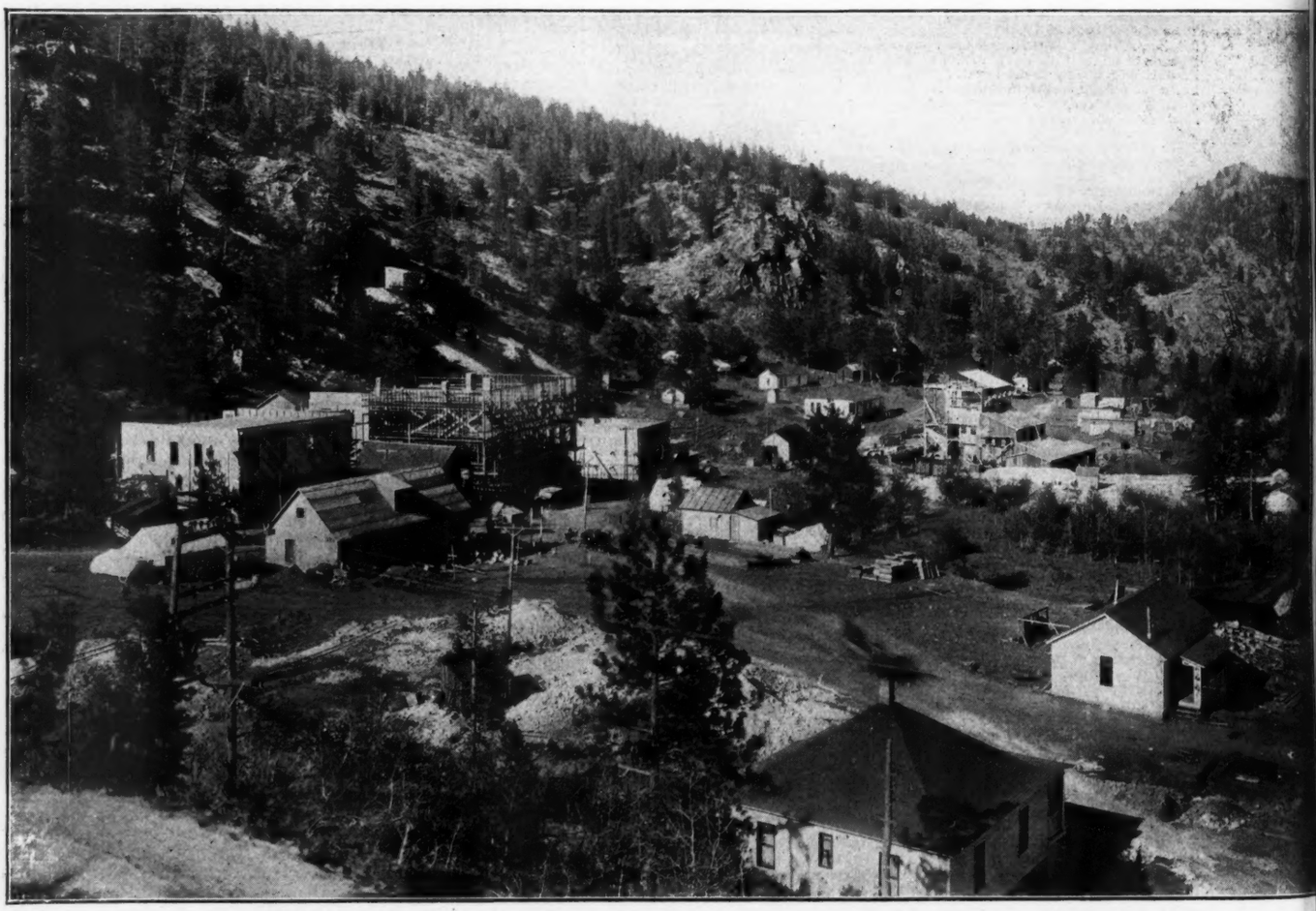
The Alaska Treadwell Gold Mining Co., operating at Douglas Island, Alaska, reports profits of $718,521 and dividends of $650.000 for the year 1915. There was 900,211 tons crushed, yielding $936,092 in free gold and 19,177 tons of sulphurets yielding $892,631, or a total of $2.03 per ton of ore against 910,285 tons of ore in 1914 yielding $2.60 per ton. There was 7,284 ft. of development work performed by the Alaska Treadwell in its own ground, 14 ft. in Alaska United ground, and 3,696 ft. of joint work by Treadwell, United and Mexican. There was only 613,063 tons of ore broken during the year, the remainder of the material sent to the mills being drawn from stock on hand. Ore reserves at the end of the year were 6,611,571 tons of ore in place and 401,184 tons broken, but the estimate of ore in places includes that which must remain in pillars. The central steam-power plant was increased to 4,750 kw., while about $10,000 was expended in improvements on the hydro-electric plant. Development costs were $18.42 per ft.; stoping cost, $0.525 per ton; tramming, $0.114 per ton; hoisting, $0.10 per ton.

Views of the Boulder County



PANORAMIC VIEW LOOKING NORTH TOWARD NEDERLAND, THE

This famous tungsten district is situated about 25 mi. northwest of Denver, Colo., and covers an area about 12 mi. northern end of Gilpin County, where a custom mill has recently been built. Nederland is at an altitude of 8,237 ft. Nederland, or the entire journey may be made by auto stage



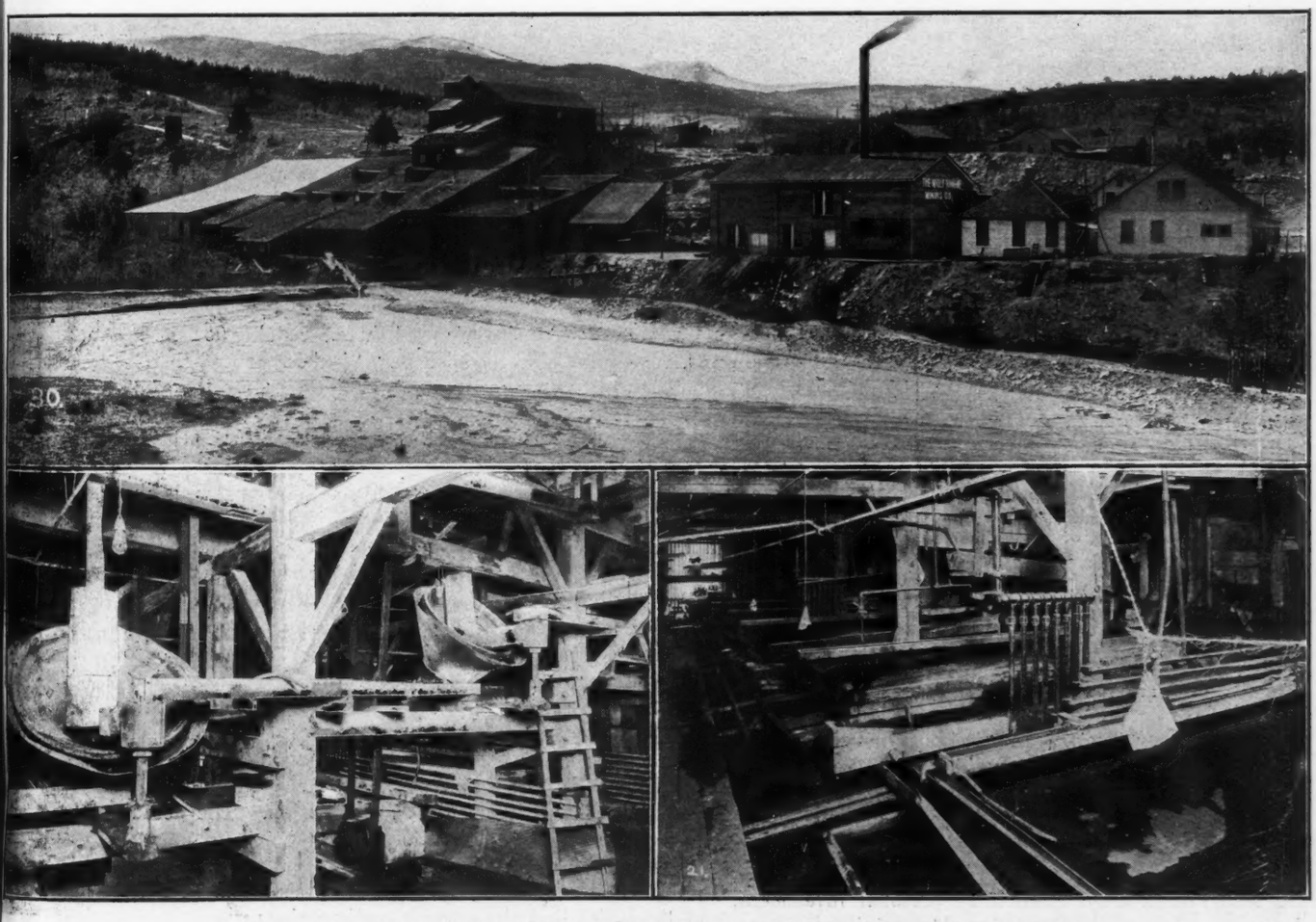
STEVENS CAMP, ONE OF THE NEW TOWNS IN THE BOULDER TUNGSTEN DISTRICT

This is one of the new sections of the district. These buildings have practically all been erected since Jan. 1, 1916. New bank building at left and Vasco No. 5 mill being erected in right center

Tungsten Field in Colorado

COMMERCIAL CENTER OF THE BOULDER COUNTY TUNGSTEN FIELD

long and 7 mi. wide. With the extraordinary development of the last year, this tungsten field has been extended into the and is reached by the Colorado & Northern R.R. from Boulder to Cardinal and then by wagon or automobile, 2 mi. to



MILL OF WOLF TONGUE MINING CO., ONE OF THE LEADING TUNGSTEN PRODUCERS

Note the newly completed "rag plant" at the left of the upper view. The two interiors, below, show the Bunker Hill screens and the Card and Wilfley concentrating tables

Correspondence and Discussion

Was Graves Our First Engineer?

A short time ago I had the good fortune to run across a copy of "The Great Industries of the United States," published in 1873 by J. B. Burr and Hyde, Hartford, Conn., no doubt by subscription, as the volume has the familiar make-up of contemporary works of that character. This book, while in great part anonymous, contains much interesting matter of a type rarely found in purely popular works. It seems to have been written by a trained and intelligent writer, who had made considerable historical research, and to whom the few palpable "write-ups" therein must have been thorns in the side. The work, moreover, at the present day is more than interesting in the basis of comparison it affords between the condition of several of our industries, which at the time of publication were considered extraordinarily prosperous, and their present expanded state. The articles descriptive of any particular industry are generally prefaced by notes of the history of that branch of the arts, and the following excerpts from the chapter entitled "Iron and Its Preparation" may be interesting to readers of the *Journal*.

After speaking of the early attempts of the London Company in 1610-23 to utilize the iron ores of Virginia, attempts frustrated in great part by a general massacre by the Indians in the latter year, which stopped the production of iron until 1712, the writer goes on to Massachusetts and says as follows:

> With the enterprise for colonizing Massachusetts Bay, the Court of Assistants in London, who took an active part in the measure, contemplated the production of iron. The journal kept of the proceedings of the court states that at a meeting held on Mar. 2, 1628, "also for Mr. Malbon it was propounded, he having skill in iron works, and willing to put in £25 in stock, it should be accounted as £50, and his charges to be borne out and home from New England; and upon his return and report on what may be done about iron works, consideration to be had of proceedings therein accordingly, and further recompense if there be cause to entertain him." Three days after, an arrangement was made with Thomas Graves, of Gravesend, Kent, to visit New England at the expense of the company as "a man experienced in iron works, in salt works, in measuring and surveying of lands, and in fortifications, in lead, copper and alum mines." On his part Graves agreed to serve the company six or eight months for a free passage out and home and £5 a month with board. If he remained three years, the company was to transport his family and to support them to the next harvest, pay him £50 a year, give him a house and 100 acres of land, with a share in the land allotment; while any additional compensation was at the company's discretion. Whether Graves, who settled at Charleston, discovered any mines does not appear. No steps were taken toward the manufacture of iron until 15 years after this date.

If Mr. Malbon was not the first metallurgical expert and Thomas Graves the first qualified mining engineer to visit this country, then who were? It will be noticed that Graves did not disdain agriculture, and his experiences in fortification would have fitted him for a place in the public eye at the present time. Mr. Malbon, it is seen, was ready to back his opinion by personal investment, also more or less on the lines of modern mining-engineering finance. If some of the readers of the *Journal*, inclined to research, would endeavor to find more of the history of these early worthies, it would not seem wasted labor to place something of their achievements on permanent record.

LOUIS JANIN, JR.

Patton, Calif., June 6, 1916.

Error in Formula for Sag*

I was interested, a short time ago, in an article on engineering formulas. The author dwelt mainly on the probability of mistakes in such formulas and the carrying of those mistakes from year to year through many editions of well-known engineering books. The fact that several books carried the same formulas without the errors being discovered was considered by the author sufficient proof that engineers in general are careless or have too much confidence in one another.

I recently discovered a mistake made in some way or other by an author or printer some twenty or so years ago in the following formula for sag. Instead of "inches" the definition of D should read "feet."

$$S = \frac{PL^2}{8D} + PD$$

where

S = Tension on a sagging rope close to the pulley;
P = Weight of rope per foot;
L = Distance between pulleys in feet;
D = Sag of rope in *feet* (not inches).

Wherever I have found the original article copied, the mistake has been copied also. Kent's Mechanical Engineering Handbook and Same's handbook both repeat the error. The original article appeared in Vol. XII of the A. S. M. E. "Proceedings," under "Rope Driving," by C. W. Hunt, and "inches" is used there. Catalog 054 of the C. W. Hunt Co. also copied it as "inches."

The error may or may not be serious. Since the same formula is applicable to computations for strength of belts, overhead cables, trolley lines, suspension bridges, wires, etc., it is quite possible that someone has inadvertently used the formula in such computations with the result that, with additions of ice or wind loads, they have broken and trains have been tied up. I do not claim that this formula has been the cause of wire breakdowns, but I repeat that it is quite possible that such is the case, for I stumbled across the error myself in connection with making computations for sag in belting. I would also have used it in connection with any suspension problem.

To prove that this error could easily lead to a breakdown, take a sag of ½ in. in a wire 30 ft. between supports, weighing 0.43 lb. per ft. Substituting in the formula as "feet," I get about 1,160 lb. tension. Substituting as "inches," it is only 97 lb. tension. The actual tension, then, would be 12 times the computed.

Since this selfsame formula is applicable to anything uniformly loaded, sagging as per Nature's catenary, I am of the belief that the error is really serious.

New York City. S. F. WILSON.

*"Power," June 20, 1916.

The Consolidated Amador Mines

By Lewis H. Eddy*

SYNOPSIS—The Consolidated Amador Mines, previously known by several names, is an old Mother Lode property, opened before 1852. After a varied career the property fell into the hands of Mrs. Hetty Green. It lay idle a number of years, but has recently been acquired by T. Walter Beam and associates, who will unwater and develop it.

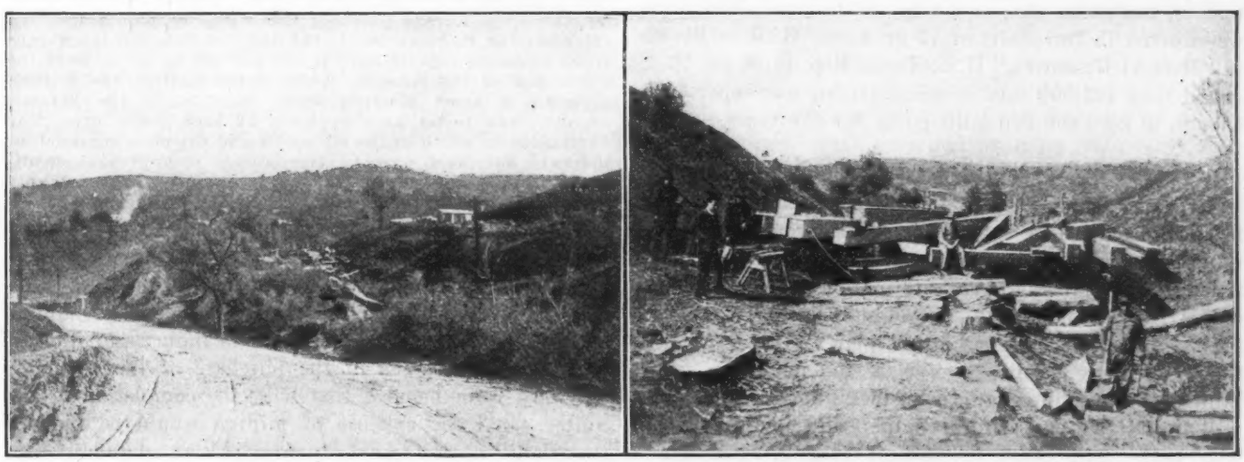
The Consolidated Amador Mining Co., of which T. Walter Beam is president and manager, began unwatering the Eureka-Badger-Summit mines at Sutter Creek, Amador County, Calif., in May, 1916. The company, formed of several stockholders of the United States Steel Corporation, purchased the property outright in February, 1916, from Mrs. Hetty Green, of New York, for cash, at a price approximating $500,000. Preparatory work for unwatering and developing, placing foundations for hoist and other equipment and the construction of necessary buildings was begun in March. Unwatering the old Eureka shaft started in the first week of June. The one-story brick building erected for and used as a company store during the early life of the mines, when Alvinza Hayward was sole owner of the property, and still in good repair, has been remodeled inside and partitioned into convenient office rooms.

The new equipment consists of Wellman-Seaver-Morgan hoist, and Cameron No. 9 pumps for unwatering. The hoist will be used initially for placing the pumps and carrying the men into the shaft as the water is lowered and permanently for deepening the shaft and for the usual hoisting in the operation of the mine. The hoist has a total capacity of 4,000 ft. depth, lifting 16,000 lb. The rope speed is 1,000 ft. per min., 1⅛-in. plow-steel rope being used. Compressed air is the initial power for unwatering, but the permanent power for mine operation will be electricity, and centrifugal pumps will be used when the mine is in operation. The Pacific Gas and Electric Co., which supplies the mines of the Mother Lode, has a power line across the property.

*Associate editor, 3430 Peralta St., Oakland, Calif.

The property is situated at an elevation of 1,500 ft. above sea level, just east of the town of Sutter Creek and south of the stream of that name. The Wildman-Mahoney abuts the old Eureka on the north and the Central Eureka adjoins it on the south; the South Eureka, Oneida, Kennedy and Argonaut cover the southerly portion of the Mother Lode between Sutter Creek and Jackson. The purchase by the Consolidated Amador includes over 3,300 ft. on the Mother Lode, of which only 1,200 ft. has been even partly prospected, the remainder being virgin ground. But little crosscutting was done by the former operators, a feature of mining since deemed essential in this region.

The greatest vertical depth sunk by the former owners was 2,060 ft. Three shafts were sunk at an incline of 70° east, following the general dip of the veins. These shafts and drifts on the veins and a small amount of crosscuts aggregated approximately 11,000 lin.ft. The underground excavation is estimated at over 7,000,000 cu.ft. The mines were in operation for about 30 years. The mine makes about 200 gal. of water per minute, and it will require about six months to take the water out. Exploration and development will proceed as the unwatering progresses.



SITE OF OLD EUREKA SHAFT AND PREPARATIONS FOR RETIMBERING IT

The history of these mines dates back prior to 1852, when originally developed by Alvinza Hayward, whose subsequent mining operations extended into most of the quartz-mining districts of the northern half of California. The property has been variously known as the Hayward, the Old Eureka, the Amador Consolidated and the Hetty Green in about that order. Alvinza Hayward started it in the early 50's and Hetty Green finished it in the middle 80's, so far as the past history is concerned; the future remains with the Consolidated Amador Mining Co. Various estimates have been made by mining men acquainted with the operation of the Old Eureka, as the property is commonly known, as to the amount of gold produced in the 30 years or more of active operation. These estimates vary from $10,000,000 to $22,000,000. I have it from men who were closely associated with Mr. Hayward in both social and business relations, and more-

over were then and are still engaged in the operation of Mother Lode mines, that the property produced approximately $17,000,000. This figure, however, may include only the period of Hayward's exclusive control.

In 1852 Hayward installed a 10-stamp mill on the Eureka mine and in 1856 built a new mill of 20 stamps and added 20 more stamps to this mill in 1857. In 1858 he purchased the Eureka mine and in 1859 became the sole owner of the Badger, consolidating these two claims as the Hayward mine. During the following 10 years three shafts had been sunk to depths of 760 ft., 960 ft. and 1,230 ft. The mine made about 4,500 gal. of water per day, which in June, 1868, was being hoisted in buckets from the north and the south shafts. This water increased in a few months to double that amount. At that time the two mills were dropping a total of 46 stamps, having a combined capacity of 80 tons of ore per day. Some of the ore was sent to custom mills. The gold was nearly all free, and amalgamation was chiefly inside and on copper apron plates. The first 200 ft. of the Badger did not pay; then the vein got wider and the ore richer. Within 500 ft. of the surface the yield did not exceed $11 per ton, but at the 1,000-ft. point a wide vein was disclosed and the grade of ore had increased to $27 per ton. The mine employed 60 miners, 12 blacksmiths and engineers and 25 others as feeders, amalgamators, teamsters, etc., or a total of 97 men. The mine was worked in two shifts of 10 hr. each. J. Ross Brown in "Mineral Resources," U. S. Treas. Rep. 1868, pp. 75-6, stated that 125,000 tons of ore in sight, was reported—enough to keep the two mills going for five years.

Authoritative Information Scarce

Mr. Brown accounted for the absence of authentic first-hand information by explaining: "The proprietor of the mine has a great fear of being suspected of seeking publicity, and he refuses to give information about the details of his receipts or expenses, or even to communicate his experience or his opinions about quartz mining." This fine satire may have been lost on the man who made millions by minding his own business, but it was and is well appreciated by California miners and newspaper men who never had cause to suspect that Alvinza Hayward would ever divulge any information about his own business for the benefit of the public. The report continues: "It is therefore necessary to rely upon statements of persons not connected with the mine for the yield, and they say the total has been $6,000,000; gross last year $27 per ton, net $22 per ton; amount of rock worked in 1866, 30,000 tons; profit that year, $660,000. Quartz in sight estimated will yield $3,375,000 gross, $2,750,000 net."

In April, 1870, the main shaft was burned and in consequence the mine was idle for four months; but notwithstanding this delay the report of the company secretary showed receipts for the year from proceeds of ore, $301,553, and receipts from all sources, $341,701; construction of shaft, etc., $98,298; mine account, $63,405; general expenses, $20,887; showing a profit on 8 months' operation, in addition to repair costs, of $139,111, from which dividends amounting to $111,000 were paid. It was nearly 18 months before the property was again in complete working order and new hoisting works installed, which Rossiter W. Raymond stated in his United States Mint report of 1872 to be the best and most complete shaft and hoisting works on the coast. In the place of the old bucket plan of hoisting rock, a substantial track was installed on which iron cars capable of holding 18,000 lb. were run and speedily hoisted to the surface. At that time there were two sets of hoisting works, each driven by an 80-hp. steam engine.

The old shaft was down 1,250 ft., inclined 70° east, on the ledge 10 ft. thick at the bottom. The new three-compartment shaft at the same incline was down 1,300 ft. The mine was then one of the deepest in California and was equipped with one 40-stamp mill steam driven by a 75-hp. engine and crushing 80 tons per 24 hr.; and two 16-stamp mills driven by water power. The company employed regularly 100 men. From 1866 to 1872 the ore averaged $20 per ton, supplying 40 stamps. The Tenth Annual Report (1890) of State Mineralogist William Irelan, Jr., contained the following interesting paragraph regarding geological features of the Eureka and Summit mines, then known as the Amador Consolidated, which had been idle for several years:

> North of that portion of the ground known as the Eureka claim, in which the great bonanza occurred, the slate intervening between the greenstone hanging wall and the west country greenstone is very wide. A very short distance north of the north end of the Eureka claim this slate is about 1,000 ft. wide, while immediately south of this north boundary and directly west of and facing the huge bodies of high-grade ore constituting the Eureka bonanza, this slate suddenly narrows to a width not exceeding 150 to 200 ft. Throughout the whole length of the Eureka oreshoot this width is maintained, and after passing it, going south, the distance between the greenstone increases rapidly until it reaches 500 to 650 ft. near the north end of the Summit, which abuts against the Eureka ground. A short distance south of this, in the Summit ground, was found another body of high-grade ore. The diminution in width of the slate belt and the near approach of the east and west country greenstones may present conditions peculiarly favorable to the formation of these highly metalliferous veins of quartz.

Change of Ownership

About 1873 Captain Green, who was a deep-sea shipmaster, fell in with Alvinza Hayward on one or more of his visits to San Francisco and was induced to interest some English friends in the purchase of the property. Hayward recommended that with the completion of the Sutter canal the expense of milling would be reduced materially, as the canal would yield an abundant and unfailing supply of water for milling and power. The new owners took hold and proceeded to deepen the shaft from the lowest level, 1,665 ft. to the 2,000-ft. point. The mine at that time had a large reserve of low-grade ore which could be profitably worked by water power, reducing the milling costs to $1 per ton. This ore kept the 40-stamp mill going, and in 1880 a new 1,500-ft. shaft was sunk with 12 men in three shifts of 8 hr. each. Drifts were run from this shaft in three directions, and the waste rock loosened on the night shift was stored or used for filling, so that hoisting was confined to the day shift.

Captain Green, with his English friends, acquired an interest or shares in the Amador Consolidated, which consisted of a large majority of the stock. Then, the story goes, when Hayward found that prospecting and development were essential parts of economic mining and he was not getting it all for himself, he began to unload his stock to Mrs. Hetty Green. He was not given to dividing his profits, and when it became necessary to expend a large amount of money to make a fair profit in mining, he usually dropped it. Hayward was also unlucky in

respect to fires in mines. Another fire in this property, at the lowest level, occurred shortly after the Greens became interested, and after it was extinguished only the levels above the 800 were mined. The repairs did not extend below that level; and after the ore above the 800 level was extracted, the mine closed and was allowed to fill with water. By this time Hayward was out of it and Mrs. Green was in. The English shareholders became delinquent in assessments for taxes. Mrs. Green finally came to own all the shares. Her idea was that it was a good investment for her son, Colonel Green, if he should be inclined to mining, but he was not so inclined.

Mrs. Green believed that the fires and other mishaps were the work of persons desirous of taking the mine away from her. Every attempt to secure an option of purchase or a lease was met with a blunt refusal to consider anything but a direct and outright sale for cash or an equivalent, and only to mining men who were strong enough to reopen and operate it, as she had unbounded faith in the value of the property. Mr. Beam tried for three years before he could get Mrs. Green to listen to him. When she came to understand who made up the company subscribing to the purchase, she said she was "not afraid of that crowd financially," and they could have the mine "for cash—take it or leave it, and no more talk." They took it. The entry into the Mother Lode region of these men who are operating extensively in other parts of the country adds another great mining enterprise to Amador County. Mr. Beam deserves success for having formed so strong a company and for his persistence, which secured what is believed by other competent mining engineers to be one of the great mines of the Mother Lode.

Oil-Well Fires Caused by Static Electricity

The origin of oil-well fires has been investigated by J. T. Hayward, who comes to the conclusion that many of them are caused by an electric discharge brought about by momentarily turning the entire well into a huge Leyden jar. The casing forms the outer coating and the bailer the inner, while the intervening air or gas is the dielectric (*Petroleum Review*, May 13, 1916). The jar is charged through the bailing line, from electricity generated by friction on the various drums or sheaves. To prevent such fires, he says all metal surfaces should be earthed and the band-wheels, shafts, etc., should run in metal bearings, one of which should be earthed. He also advises the use of a silent-discharge comb on every belt.

This silent-discharge comb is most cheaply made as follows: A strip of sheet iron 100 mm. wide and slightly longer than the width of the belt is nailed upon a piece of board, the nails passing clear through the board. One of these should be placed across the belt not more than an inch from the inside and earthed. It is preferable to use one after each pulley.

Oil Production for 1916

The quantity of petroleum marketed in the United States during the first half of 1916 is estimated by John D. Northrop of the United States Geological Survey at 140,000,000 bbls. This estimate is moderate and the apportionment of the output among the major fields is as follows: Appalachian field, 11,400,000 bbl.; Lima-Indiana field, 1,800,000; Illinois field, 7,900,000; Kansas and Oklahoma field, 50,500,000; Northern and Central Texas field, 4,200,000; Northwest Louisiana field, 6,800,000; Gulf Coast field, 11,400,000; Wyoming and Montana field, 2,400,000; California field, 43,500,000; miscellaneous (Colorado, Michigan and Missouri), 100,000 bbl.; total, 140,000,000 bbl.

This quantity, which includes a little oil actually produced in 1915 but marketed during 1916, is less than the output during the first half of 1915, though it is greater than one-half the entire quantity marketed last year. The fact that this quantity reflects the results of general activity throughout all oil-producing areas rather than flush production in restricted areas is significant and leads to no other conclusion than that the final statistics of oil marketed in 1916 are destined to establish a new record.

Prosperity in American Mining; Record Production Predicted

"The accomplishments of the mining industry in the six-month period just completed warrants the forecast that 1916 is to be a record-breaking year." With this statement the director of the United States Geological Survey sums up his official midyear review of the mineral industry as reported to him by the Government geologists and statisticians covering the different subjects.

Shipments of iron ore from Lake Superior points for five months of 1916 exceeded by more than 80% those for the same months in 1915, and the indications for the year are favorable for a new high record on iron-ore production and of pig iron as well. Higher prices with a steady demand are stimulating the mining of manganese, with the result that this year's output of ore is expected to surpass the large production of last year.

Most precious-metal mines are operating at full capacity. The gold production will probably fall below the high yield of last year, but silver is expected to break all previous records.

Copper is continuing the steady increase in production which began early last year, and the forecast for 1916 indicates not only the largest output ever known, but also the largest profits.

The lead and zinc mines are producing ore at a rate exceeding that of last year, and the prevailing prices have made possible the working of large quantities of low-grade ore.

In quicksilver mining the outlook is for an output similar to that of 1915, which was the largest for several years. Thus far in 1916 the average price has greatly exceeded the 1915 price.

The reports from the Survey's Western offices are all optimistic. In Arizona mines and smelters are working at high pressure and the production of metals already shows an increase that promises to make the value of the output nearly double that of last year. Arizona will maintain first place as a copper producer. New Mexico is continuing its rapid progress as a metal-mining state, with increases in its output of lead, copper, zinc, gold and silver. The mines of Colorado in the six months just past have shown some changes in output as compared with last year; an increase of 30% in copper is indicated, together with small gains in lead and zinc, a 15%

decrease in gold and little change in silver. This output, however, represents a large gain in value of mine production. Mining has also been stimulated in Montana, and the forecast indicates an increase of 60% in the value of the mine product over that of last year. Idaho mines are increasing their shipments in all the metals, with higher wages and dividends as the result of better prices.

Utah is experiencing an ore production in excess of smelter capacity. The value of the 1916 output of copper is expected to be double that of last year. Throughout Nevada old mines are being reopened and regular producers are working at full capacity. The chief gains in production will be in copper, lead and zinc. The increased activity in the mining industry of California is found largely in the reopening of mines long idle and in the opening of new mines for chrome, tungsten, manganese antimony and magnesite, rail shipments of these ores to the East being made possible by prevailing high prices. In Alaska copper mining is showing advances and both copper and gold promise to exceed last year.

Foreign Trade in Lead and Zinc

The imports of lead into the United States for May and the four months ended May 31, are reported by the Department of Commerce as below, in pounds:

	May	Five Months
Lead in ore	2,068,788	11,202,259
Lead in base bullion	.....	13,793,189
Lead, metallic	15,198	2,558,857
Total lead	2,083,986	27,554,305

The actual tonnage of lead ore was 7,875 tons, of which 4,932 tons came from Mexico, 2,148 tons from Canada and the remainder from Guatemala, Chile and Peru.

Imports of zinc in all forms in May and the four months ended May 31, are reported by the Department of Commerce as below, in pounds:

	May	Five Months
Zinc in ores	40,741,730	168,631,067
Metallic zinc	121,565	683,427
Zinc dust	201,186	1,069,756

The zinc dust imported in May came from Japan (113,014 lb.) and France (88,172 lb.). The total ore imported in May was 38,425 tons; 10,267 tons being from Mexico, 54 tons from Guatemala, 3,502 tons from Canada, 12,544 tons from Spain, 1,476 tons from French East Indies, 1,280 tons from China and 9,501 tons from Australia.

Exports of zinc from the United States in May and the four months ended May 31, were, in pounds:

Exports	May	Five Months
Zinc, pigs, bars, etc., from domestic ore	10,187,550	57,266,448
Zinc, pigs, bars, etc., from foreign ore	9,622,366	28,095,912
Zinc plates and sheets	7,063,133	32,625,482
Zinc blocks, etc., reëxported	.....	336,000
Total metallic zinc	26,873,049	118,323,842
Zinc dross	.....	3,211,446
Zinc dust, reëxported	14,998	112,417

Exports of lead during May in the form of pigs, bars, etc., produced from domestic ore, amounted to 15,030,880 lb., and from foreign ore, to 1,281,153 lb.

Leasing of Forfeited Mineral Claims is now possible in British Columbia since the passing of the "Taxation Act Amendment Act, 1916," recently. Upon the payment of $25 per year the leaser has all the rights of a free miner under the Mineral Act. He may obtain a crown grant of the property if he shows that he has done $200 worth of work per year during the continuance of his lease and the payment of any back taxes or dues.

A Siberian Mining Company

The Maritime Province, Siberia, contains deposits of silver, lead and zinc, the working of which began in 1909. One company built a concentrating plant at a cost of $500,000 in 1914. It proved a success, and in 1914 the output consisted of 90.66 tons of lead concentrates, averaging about 71% lead, 4.5% zinc, and 1,100 gr. of silver, as well as 194.14 tons of concentrates, containing 33.5% zinc and 7% lead. According to official figures, the output in 1915, from 5 out of 11 mines belonging to the company, amounted to over 30,000 tons of lead ore. The undertaking is increasing its output each year; it began in 1909 with only 97 long tons of silver-lead ore and increased the output in 1913 to 29,956 tons. In 1914 and 1915, on account of the war, the production was smaller.

According to a commerce report issued recently by the Department of Commerce, Washington, D. C., the company owns 11 deposits covering an area of over 2,635 acres, and in addition, a gold deposit covering 191 acres; it also rents from the government 1,350 acres of land for various purposes. The mines are equipped with 180 buildings, costing $252,500; a concentrator, costing $500,000; a narrow-gage railroad, 23 mi. long, costing $159,000; an aërial cableway, costing $29,500; and conveyors, wharves, wagon roads, etc., costing $18,000. As the greater part of the capital invested in this enterprise is German, the management of the undertaking is intrusted to a special board of temporary managers.

NEW PATENTS

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

ALUMINATES—Production of Aluminates from Alunite. Paul R. Hershman and Raymond D. Cooke, Chicago, Ill., assignors to Mineral Products Corporation, New York, N. Y. (U. S. No. 1,189,254; July 4, 1916.)

CONCENTRATOR—Ore Concentrator. Rudolph Leonhart, San Anselmo, Calif. (U. S. No. 1,190,306; July 11, 1916.)

CRUSHER—Rock Crusher. Frank B. McCabe, Lewiston, Penn. (U. S. No. 1,189,594; July 4, 1916.)

CRUSHING—Ball Mill. Ernest S. Gregory, Anaconda, Mont. (U. S. No. 1,190,401; July 11, 1916.)

DIGGING AND CONVEYING APPARATUS. Robert P. Greenleaf, Hudson, Ohio, assignor to Frank Billings, Cleveland, Ohio. (U. S. No. 1,189,443; July 4, 1916.)

DRILL—Rock Drill. Andrew L. Engels and Joseph Walker, Bisbee, Ariz. (U. S. No. 1,190,387; July 11, 1916.)

ELECTRIC FURNACE. Peter Eyermann, Witkowitz, Austria-Hungary. (U. S. No. 1,189,356; July 4, 1916.)

ELECTROLYTIC CELL and the Process of Electrolyzing Metal. Christian Dantsizen, Scotia, N. Y., assignor to General Electric Co. (U. S. No. 1,190,122; July 4, 1916.)

FERROMANGANESE—Process of Producing Ferromanganese Alloys. Harry Schagrin, South Bethlehem, Penn. (U. S. No. 1,190,679; July 11, 1916.)

FLOTATION—Oil and Acid Feeder. Albert Campbell, Anaconda, Mont. (U. S. 1,190,721; July 11, 1916.)

FLUE DUST—Process for Reducing Flue Dust and Other Metal Fines. Samuel L. Boggs, Pittsburgh, Penn. (U. S. No. 1,190,772; July 11, 1916.)

INGOTS—Apparatus for and Process of Casting Ingots of Metals and Alloys. Pierre Henri Gaston Durville, Paris, France. (U. S. No. 1,189,548; July 4, 1916.)

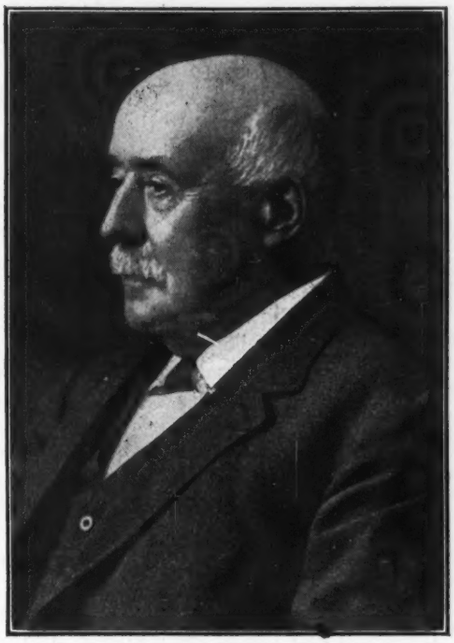
LEACHING—Process of Recovering Values from Ores. Henry Hirsching, Oakland, Calif. (U. S. No. 1,190,549; July 11, 1916.)

LOCOMOTIVE with Haulage-Cable Mechanism. Dudley T. Fisher, Columbus, Ohio, assignor, by mense assignments, to the Jeffrey Manufacturing Co. (U. S. No. 1,190,394; July 11, 1916.)

METAL COATING—Flux for Coating Metal Baths. James H. Maddy, New York, N. Y., and Bruno H. Schubert, Weehawken, N. J., assignors to the Lohmann Co., New York, N. Y. (U. S. No. 1,189,373; July 4, 1916.)

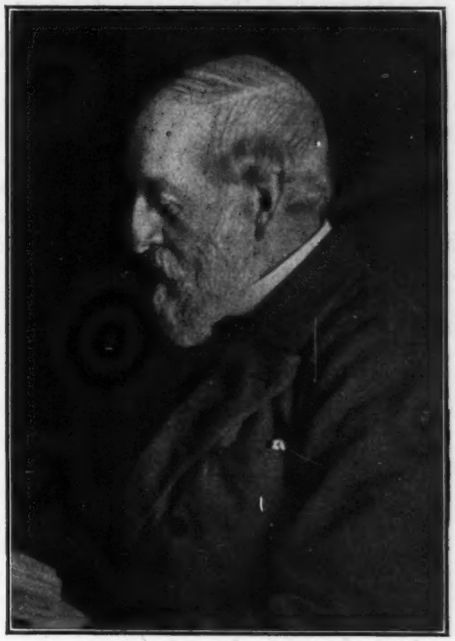
ROASTING—Process of Treating Metalliferous Materials for Roasting, Reducing, Sintering, and Like Processes. Friedrich Carl Wilhelm Timm, Hamburg, Germany. (U. S. No. 1,189,313; July 4, 1916.)

Men of the Calumet & Hecla



ALEXANDER AGASSIZ

The builder of Calumet & Hecla and for many years its executive head. Under him the company attained its great prestige, made its wonderful record of dividends.



QUINCY A. SHAW

The able coadjutor and friend of Alexander Agassiz. One of the promoters of the Calumet & Hecla Mining Co. and its first president. Mr. Shaw died in 1908

RODOLPHE L. AGASSIZ

Son of Alexander Agassiz, and present president of the Calumet & Hecla company

TIMOTHY O'SHEA

The oldest employee of the Calumet & Hecla company, having worked for it continuously for 50 years and six months

Editorials

The Proposed Tax on Copper

The more carefully is examined the proposed tax on copper the more unfair does it appear to be and the more bungling in its operation if it be enacted in its present form. This tax is to fall primarily upon refiners and manufacturers. Smelters are not to pay anything directly unless they sell their copper for immediate consumption. The producers of copper who are miners only are not called upon to pay anything. The incidence of this tax will therefore be as follows:

1. Upon refiners who are sellers. If the refiner treats raw material on toll, as the A. S. & R. Co. does for the Utah Copper Co., he will hand back the refined copper to the customer and the latter will pay the tax. If, however, he treats raw material that he has purchased, he will have to pay the tax. The tax may then be charged up to the smelter and by the smelter to the miner from whom he gets the ore, but if either the refiner or smelter or both are treating material on long-time contract, the tax cannot be thrown back. If the refiner is treating crude copper for a selling agency, the latter will have to pay the tax. Here is a fine complication that is not only based upon injustice in principle, but will without any doubt make the assessment of the tax dependent upon a series of arbitrary Treasury decisions, no matter how Congress tries to phrase it.

2. Smelters and refiners like the Lake companies will have to pay the tax.

3. Smelters that sell pig copper to consumers will have to pay the tax.

4. Brass makers will have to pay the tax, and in their case the copper on which refiners have already paid will have to pay again—a double taxation that will apply to about 30% of the copper consumed domestically.

Furthermore, it is to be remarked that these companies that will have to pay on their product are obliged to pay the regular income tax on their net profit. Also that these companies are already required to pay a large part of the local taxes in the States wherein their properties are situated. In Arizona, for example, the major part of the expense of running the state is borne by the copper companies.

Congress proposes to exempt the copper companies when their profit falls below 10%, and graciously, but correctly, permits capital charges to be included in the cost. However, the actual cost of producing copper is a question respecting which experts have been disputing for the last 10 years without coming to an agreement, and that is going to be a fine mess into which to inject the taxgatherers of the Treasury Department.

These arguments should not divert attention from the unfairness of the whole project. Congress has been for a year back considering new taxes. Among other things it was proposed to tax gasoline. There was such a protest against a tax on it, which would affect millions of voters, that the politicians did not venture to risk it. Apparently in casting their eyes around they noted the large profits that the copper companies have been making and concluded that there was an industry wherein a tax would be paid directly by so few people that their objections could be disregarded. Otherwise, why copper?

Copper has not figured among the war brides any more than iron and steel, lead, gasoline and a hundred other commodities. The maximum price for it in 1916 has been but a few cents a pound higher than in 1907, when there was no war. In the copper industry there was no such extravagance as in others wherein the price rose to four, five and ten times normal.

That there has been a great demand for copper for military purposes, let it be granted. But if money is to be raised by taxation on that ground, why should it not be raised from *all* commodities that have been enhanced in value on that account?

The London Standard Copper Market

Upon several occasions during the last year the *Journal* has referred to the absence of real meaning that has come to pass in transactions in copper on the London Metal Exchange and the insignificance of the quotations that are cabled broadcast from there. Renewed attention has lately been drawn to this subject.

In normal times the London Standard market offered free facilities to anybody to buy and sell through a member of the London Metal Exchange, so that the quotations there, supposedly, reflected the opinion of pretty nearly the entire world interested in the metal dealt in. To affect the quotation either up or down there would have to be transactions of considerable volume.

Last March the British Government put restrictions on dealings on the London Metal Exchange so that purchases could only be made for actual consumption in Great Britain, and since then no one has been allowed to sell unless he has the metal or can show documentary evidence of its being afloat. Furthermore, there is a British export embargo on all metals. Necessarily the dealings on the exchange are thus limited to consumers in Great Britain, and practically they can buy only spot metal. As there is now hardly any spot metal in Great Britain except about 1,000 tons of undesirable arsenical Standard copper, there is no inducement for the British consumer to go to the exchange for his supplies.

The result developed by this state of affairs is that the few dealers who have affiliations with consumers can

LONDON QUOTATIONS AND SALES OF STANDARD

Date	Spot	Futures	Sales, Tons	Date	Spot	Futures	Sales, Tons
June 9	£123–10	£119–10	..	June 27	£102	£98	75
12	121–10	119	..	28	103	100	75
13	121	118–10	..	29	104	100	25
14	118	116	..	30	103	100	25
15	113	110	..	July 3	102	98	100
16	113	110	..	4	98–10	94–10	50
19	110	106	25	5	96–10	94–10	50
20	106	103	100	6	97	95	..
21	98	96	25	7	91	89	50
22	97	95	50	10	84–10	82–10	..
23	98	96	50				
26	102	99	75	Tons			775

work the market in either direction by the purchase or sale of a single 25-ton lot. The quotation is sent broadcast to the world, as heretofore, but the majority of persons who note the quotations are ignorant of the changed conditions. How altered are the conditions is evinced by the accompanying statement of the sales on the London exchange during the period from June 9 to July 10, both dates inclusive. In that period of one month there was sold 775 long tons—1,736,000 lb. About 200,000,000 lb. per month has to be sold monthly on the average by American refiners to dispose of their output.

On the strength of those trifling transactions there was a decline of about £40 per ton, equal to 8½c. per lb. Even more rediculous is the showing of a downward plunge, an upward swing and another downward plunge on transactions whereof the maximum in any one day was only 100 tons.

The object no doubt aimed at by Great Britain was to discourage wildcat speculation, and we cannot find fault with any means the government may have chosen to accomplish that object, but it would appear that the only result attained is to make the London Metal Exchange look ridiculous. It would be far better to close the exchange altogether for all the service it renders the public. To the producers these quotations are meaningless and worthless, but the general public does not know it. As we have previously remarked, American producers long since ceased to pay any attention to them.

Matte or Regulus

The Board of General Appraisers of the Treasury Department has given a decision in the long-standing dispute between smelters and the customs officers as to what is regulus of copper. This goes back to 1896, since which time it has been the subject of numerous actions and decisious, generally in favor of the importers. However, the Government has never been satisfied and has steadily been desirous of trying the case again.

The matter hinges upon the lead content. Lead-bearing ores are dutiable. Regulus of copper is free. How, then, about copper matte containing lead? Copper matte is certainly not a lead-bearing ore, but is it a regulus of copper? The United States Board of General Appraisers has decided in the affirmative. This is not only a decision of common sense, but also it conforms to metallurgical understanding.

Cost of Producing Spelter

When spelter fell to the level of about 8c. per lb., it was overlooked that that price was probably not far above what 5c. would be in normal times. For the cost of production has increased greatly in many of the important districts. There has been a large advance in the wages for labor, in the cost of explosives, and in material generally. On the other hand, there has been reduction in the efficiency of labor, which has told terrifically—in zinc smelting especially.

Some people think that the cost of producing zinc is now 40% higher than it was in 1913. On that hypothesis a 5c. cost then would be a 7c. cost now. It is certain that up to the middle of 1914 zinc producers looked upon a 7c. market as something fat, something to be expected only once in seven years or so. Fluctuations of ½ to 1c. from normal were regarded as major swings. Now producers draw long faces over an 8c. market and look for swings of several cents per pound.

Of course there is going to be a readjustment to the old order. Wages will come down; extractions will go up. Competition will reign. During the process of readjustment there will be some interesting things which probably no one is wise enough to prophesy any more than anybody could what happened in 1915.

Calumet & Hecla

On July 15 the Calumet & Hecla Mining Co. celebrated its 50th anniversary. The day was made a festival. The officers and directors of the company went out to the mine from Boston by special train, and the 5,500 employees in Calumet and vicinity were given a holiday without loss of pay. Medals—gold, silver and bronze—were presented by the company to its employees who had been in service for long series of years, and of these there are a great number. It is doubtful if there be any other great industrial company of the United States—certainly no other mining company—that can show such a record of loyalty, faithfulness and long service on the part of a large number of its men as Calumet & Hecla can. Noteworthy among them is Timothy O'Shea, who has worked with the company for 50½ years, having been one of those who dug the original pit at the discovery place. Mr. O'Shea is now the senior of all, his old officers having departed one by one. But in the administration of the company there is a continuity of service and tradition, the present president—Rodolphe L. Agassiz—being a son of Alexander Agassiz, the great president, while James McNaughton, the general manager, was born in Calumet and has occupied his present position for many years.

The Calumet & Hecla is the most successful mining company of the United States. Not only did it make wonderful returns to those who invested in it 50 years ago, but also the glamor of those returns impressed the public generally—especially the New England public—and made it interested in mining investments elsewhere and willing to risk money in them. Thus Calumet & Hecla contributed more or less directly to the development of the mining industry everywhere in the United States.

Its policy, both with respect to its attitude toward its employees and to its customers—and for that matter we may add toward the public generally—has been generous, broadminded and praiseworthy, a good model for others to pattern by. The American mining industry has been better in all ways through the presence of the Calumet & Hecla Mining Co. in it.

The idea that the United States never exercises a strong hand in foreign affairs or intervenes in them is erroneous. At the present time this country is dictating the course of events in four other countries—Haiti, Santo Domingo, Panama and Nicaragua. In Haiti and Santo Domingo the United States is actually establishing thoroughgoing protectorates. In none of these four countries has the United States Government been willing to wait for free and fair elections or intimated its intention to abide by them. Why should there be the difference in attitude toward them and toward Mexico? Is it for the reason that Mexico is conceived to be like its own prickly pears, hard to handle?

BY THE WAY

In an address delivered by W. H. Dawe, president of the Transvaal Chamber of Mines, at the annual meeting held in Johannesburg, Mar. 27, 1916, it was stated that the accident death rate for 1915 was the lowest on record, being 3.17 per 1,000 per annum for white employees and natives combined, compared with 3.22 in 1914. In 1905 and 1906 the rates were 5.15 and 5.19.

⁂

Bringing international procedure down to the "plain people" might relieve the courts of a lot of work. Perhaps infringers under the apex law might avoid responsibility by adopting the system outlined in the following story from the Kansas City *Star:*

"Yassah! Brudder Tump sho' flogged me plenty. He knocked me down and drug me around and beat me and mauled me twell muh tongue hung out."

"What yo' all gwine to do about it, sah?"

"Do? What kin I do? De gen'leman done disavow de whole incident!"

⁂

Under the caption "First Aid to Pershing," the *Saturday Evening Post* says:

A street carnival now touring the South is seemingly the repository of a most perplexing military secret. On a recent visit by this particular carnival to a Tennessee city a part of the attending throng heard a barker extol the clairvoyant powers of Madam ——.

This Goddess of Wisdom, while thoroughly blindfolded, gave instant answers to any questions. The seeker after truth merely wrote on a slip of paper the question nearest his heart, which, being read out by the barker in the hearing of all the crowd, was as publicly answered.

Whether Minnie still loved Tom and where the old hermit buried the gold were questions legitimate enough; but that somebody had taken advantage of a lady's trustful disposition her answer revealed when Madam —— was confronted with the query:

"Where is Villa?"

Her reply was:

"Her real name is not Villa. It is Margaret; and she is now in Atlanta, Georgia."

⁂

"B. C. 7—Experts on the Yellow River (China) report three plans for flood control: First, the best plan is to lead the water to the sea; second, a good plan is to divide the water and carry it over all the land by canals; third, the worst plan is to raise the banks higher. There is a proverb in China, said to date 2,000 years B. C., still inscribed on a stone monument at the head of the Min River in Szechwan to the effect 'dig deep the ditch, keep low the dikes.'"—China, an Interpretation, by Bishop J. W. Bashford.

Bishop Bashford cannot be accused of political enmity to Representative Humphreys, of Mississippi, who wants the United States to spend $45,000,000 on levees along the Mississippi River. But even the Chinese engineers of 7 B. C. reported unfavorably on the Humphreys flood control bill because they knew the plan does not work.

But what we started to say is that pork is the hardest of all things to digest, never being assimilated by the human stomach in less than 8 hr. and by the body politic in a like number of years.

⁂

The *Journal* has previously called attention to Congressman Tavenner's pernicious proposal. Respecting it the *Evening Post* remarks that at the moment when we are so afraid of Germany's efficiency as to be arming against her at an unheard-of rate, there is an ominous effort in Congress to prevent real efficiency in various directions. Thus Congressman Tavenner has introduced a bill prohibiting "time-studies" and other moves toward the efficiency of those engaged in Government work. There is also a Van Dyke bill, the object of which is similarly to make against the efficiency of the Post Office Department—than which no department is in more need of efficiency, Heaven knows. It is also reported that similar labor-union attacks upon scientific management are to take form of riders to the Post Office, Navy, Army, and Fortifications Appropriation bills. Congress has already injured the scientific-management system at our arsenals, thereby increasing the cost of the cannon that are to defend us. If these riders go through, efficiency in the Government service will be prohibited by law—and yet we think ourselves superior to Chinese administrative methods! Here is a great chance for the Security Leagues and other advocates of preparedness to do the country a useful service by preventing such legislation.

⁂

Proposed Reclassification of Spelter

Nonferrous metals and alloys were discussed at length at the annual meeting of the American Society for Testing Materials, held at Atlantic City, June 27-30. Extensive revisions in the standard specifications for virgin spelter were recommended, which consisted essentially of a change in the grading of virgin spelter by addition of the grade "Selected," the recognized grades now being as follows: *A,* High grade; *B,* Intermediate; *C,* Brass Special; *D,* Prime Western. The new grade "Selected" will come between Brass Special and Prime Western.

In the former specifications it was provided that Brass Special spelter should not contain over 0.75% lead, 0.04% iron and 0.75% cadmium. It also was to be free from aluminum and the sum of the lead, iron and cadmium was not to exceed 1.20%. This was changed as follows: Brass Special spelter shall not contain over 0.60% lead, 0.03% iron and 0.50% cadmium, and the sum of the lead, iron and cadmium shall not exceed 1%. Selected spelter shall not contain over 0.80% lead, 0.04% iron and 0.75% cadmium. It also was to be free from aluminum, and the sum of the lead, iron and cadmium may not exceed 1.25%. The previous specifications for Prime Western spelter provide that is should not contain over 1.50% lead and 0.08% iron, whereas the revision decreases the percentage of iron to 0.06, the percentage of lead remaining unchanged.

The section referring to sampling was stricken out and the following substituted: "Select 10 slabs at random from a carload and saw each slab completely across from the middle of one long side to the middle of the other, and use the sawdust as the sample; or drill three 9-mm. holes along one diagonal of each slab, boring completely through, and taking care to make fine drillings; the holes should be drilled as nearly as possible at the middle and halfway between either end and the middle of such diagonals. Go over the drillings or sawings with a powerful magnet to take out any iron which may have come from the drill or saw and mix the sample thoroughly. The drill or saw must be thoroughly cleaned before use, and no lubricant shall be used in either drilling or sawing."

PERSONALS

John T. Young has gone from Rolla, Mo., to Metcalf, Ariz.

A. W. Koch has gone from Mascot, Tenn., to Granby, Mo.

Charles E. Schwarz has gone from St. Louis to Miami, Okla.

Curtis Alexander, recently in Mexico, is now at San Diego, Calif.

W. Frank Lewis, lately at Hillsboro, N. M., is now at Ewen, Mich.

Harlan H. Bradt has gone to Duluth, Minn., from Pittsburgh.

E. H. Cook, recently at Culiacan, Mexico, is now at Los Angeles.

W. H. Moore has gone from Pasadena, Calif., to Black Diamond, Wash.

Siegfried Fischer is now at Golden, Colo. He was recently in New York.

George B. Holden, recently at Wickenburg, Ariz., is now in New York.

Andrew Walz is now at Springfield, Mo. He was recently in New York.

W. L. Lawshe is now at Seattle, Wash., having gone there from Montana.

Ben. B. Lawrence, of New York, has gone from Oregon to San Francisco.

E. D. Brewer, recently at Edwards, N. Y., is now at Buckingham, Quebec.

Orel E. Young has gone from Cleveland, Ohio, to Salt Lake City, Utah.

Gust. Setz is now at Berkeley, Calif. He was recently at San Antonio, Tex.

F. P. Williams, of New York, is now at Fomento, Santa Clara Province, Cuba.

Harold W. Yost has gone from the Great Falls mine, Potomac, Md., to St. Louis.

James Wilding, lately at the Inspiration Mill, Miami, Ariz., has gone to San Francisco.

Felix E. Wormser, of New York, is now with the Snake River Mining Co., Huntington, Ore.

G. L. Sheldon, of Ely, Nev., is in Washington County, Idaho, making examinations of mining property.

Fred S. Porter, late at Treadwell, Alaska, is now with the Canadian Klondike Mining Co., at Dawson, Yukon.

M. L. Fuller, of the Associated Geological Engineers, has started for Cuba to conduct expert investigations.

Frank C. Rork, recently at Lansing, Mich., is now with the Consolidated Arizona Copper Co. at Humboldt, Ariz.

F. Julius Fohs, consulting oil geologist, has moved into his new quarters in the new Gallais Building, Suite 307, Tulsa, Okla.

Robert W. Woolley has resigned his position as director of the United States Mint, in order to take an active part in the political campaign.

Herbert W. Gepp, H. R. Hanley and **John G. Kirchen** were elected to membership in the Mining and Metallurgical Society of America in June.

Dr. William O'Neil Sherman, of Pittsburgh, will represent the United States Steel Corporation in the hospital research work outlined by the Rockefeller Institute.

Gen. John Carson, of Montreal, who before the war was prominent in mining circles, is now one of the commanders directing the forward movement of the Allies.

On July 13 **Frederick G. Clapp,** of the Associated Geological Engineers, left for Wyoming, planning to visit also certain Kansas and Oklahoma fields before his return to New York.

M. H. Kuryla is manager of the Broadwater Mills Co., at Park City, Utah. In the "Journal" of June 24, 1916, the name of M. H. Atwater was erroneously given in this connection.

J. W. Brown has succeeded **Daniel W. Thatcher** as secretary-treasurer of Isabella Mines Co. and the main office of the company will be removed to its Lee mine on Bull Hill, Victor, Colo.

Edwin W. Mills has published in the transactions of the Korea branch of the Royal Asiatic Society, Vol. 7, Part 1, a very creditable and exhaustive memoir on gold mining in Korea.

James E. Davis, formerly superintendent of the Central Eureka mine, at Sutter Creek, Calif., has been appointed superintendent for the Calaveras Consolidated Mining Co., at Melones.

Newton Higbee, of Buffalo, representing a New York syndicate, has bought two claims and taken options on seven others in the Shining Tree district, about 90 mi. north of Sudbury, Ont.

Prof. Waldemar Lindgren went to the West in the latter part of June, where he is engaged on some professional work He does not expect to return to Boston until the latter part of August.

The vacancy in geology in the University of Kansas, caused by the resignation of Prof. W. H. Twenhofel, has been filled by the election of **Dr. Raymond C. Moore,** of the University of Chicago.

Charles Camsell, of the Canadian Geological Survey, has gone to Peace River, Alberta, to investigate the potash resources of the district and to supervise the work of three parties in the oil field.

Roy G. Mead has resigned his position as mineral examiner for the General Land Office, Department of the Interior, to become manager of the Gila Development Co. and the Troy-Arizona Copper Co. at Troy, Ariz.

Burr E. Cartwright, who has been prominently connected with the mining industries of Cobalt and Porcupine, Ont., has retired from active business on account of ill-health and has resigned the presidency of the Adanac Silver Mines .

Prof. R. C. Wallace, of the University of Manitoba, and J. S. De Lury, lecturer on Geology at the University having completed a survey of the Rice Lake gold field, have gone to make an examination of the mining area north of The Pas.

Samuel D. Nicholson, prominent mine operator of Leadville, has announced his candidacy for the office of governor of Colorado, on the republican ticket. He was defeated two years ago in the state convention for the same nomination. Mr. Nicholson is manager of the Western Mining Co., successfully operating the Wolftone mine. It is probable that he will compete for the nomination with Allison Stocker, state auditor, who also has various mining interests.

Harrison A. Dunn is still in prison in the City of Mexico. The Department of State received from its representative there a dispatch on July 17, stating that he had again made bitter representation to the Mexican Government regarding its failure to release Mr. Dunn, that the Minister of Foreign Affairs—Cabrera—claimed that the member of the cabinet corresponding to the Secretary of the Interior in our Government opposed Dunn's release on the ground that Dunn had taught the Zapatistas the use of dynamite. However, Senor Cabrera expected to be able to overcome this opposition and obtain Mr. Dunn's release at an early date. In view of the influence of Senor Cabrera in the present Mexican government, this report should be considered encouraging.

OBITUARY

Lucius L. Wittich, mining news editor of the Joplin "News Herald," died at Joplin, Mo., on June 25. For many years his name had been prominently identified with the lead and zinc industry of Missouri and particularly of the Joplin district, through his contributions to the popular and technical press and his skill in gathering and presenting statistics on lead and zinc production. He had the latter feature well organized and the results were considered reliable and representative. As a leader in local mining news circles, his loss is keenly felt and his place difficult to fill.

Hollinshead W. Taylor, senior member of the N. & G. Taylor Co., manufacturer of tinplate, died suddenly July 7 at his residence, Chestnut Hill, Philadelphia. He was born in Philadelphia in 1850 and is survived by his widow and two children. He was a member of the Union League of Philadelphia, the Down Town Club and the Philadelphia Cricket Club. He was the last of the third generation of Taylors connected with this old company, established in 1810 by his grandfather, William Taylor, and his great uncles, George and Tracy Taylor. He began his connection with the firm under his father, and his business activity in this line falls just short of half a century. It is an interesting fact that the art of tinning was introduced into England about the year 1720 by one of Mr. Taylor's ancestors, Major John Hanbury, of the Hanbury-Tracy family, at Pontypool, Wales, who established the first permanent plant for the production of tinplate on British soil. The Taylors, 170 years later, were pioneers in the tinplate manufacture in this country.

Editorial Correspondence

SAN FRANCISCO—July 12

Yuba No. 15 Dredge, at Hammonton, in the Yuba Basin field, started digging July 3. This is the eighth all-steel placer dredge built in California by the Yuba Construction Co. and the fourth all-steel dredge owned and operated by the Yuba Consolidated Gold Fields. It has 17-cu.ft. buckets and the hull is 165 ft. long, 68-ft. beam, 11 ft. 6 in. deep; this is 10 ft. greater length and beam than Yuba No. 14. Total weight of the hull is 1,700,000 lb. Total weight of dredge is more than 2,900 tons, which is about 900 tons heavier than No. 14. The dredge is designed to dig 82 ft. below the water line and has a yardage capacity of over 300,000 cu.yd. of material a month. Digging ladder is 154 ft. long; tailing stacker, 175 ft. long; the spuds 70 ft. long, including 10-ft. points. It is equipped with General Electric motors. Construction was begun Feb. 3, 1916; the dredge was launched on Mar. 26, and the same foundation and ways will be used for construction of No. 16, for which material is now being assembled. No. 16 will be of the same bucket and yardage capacity and design as No. 15, but will be equipped with two tailing stackers for the purpose of reclamation of the channel of the Yuba River.

BUTTE—July 13

Bursting of Butte & Superior's Tailing Dam on July 11 let a torrent of slime, mud and water down a Meaderville street, completely demolishing one and damaging several other homes. A number of people had a narrow escape from death by drowning. As a result of the flood, Main St., Meaderville, was impassable for 150 ft. all day long and though the flood lasted only a short time, due to the great amount of tailings deposited in the creek and around buildings, it will be several days before it has completely drained off. The break in the dam was promptly repaired.

In the Butte-New York Property, Butte & Superior is continuing development but the work is rather slow, as it is all being done on the 1,200-ft. level from the Black Rock shaft and under difficulties because of lack of facilities for handling the waste. The Butte-New York owns four claims, in which the Butte & Superior obtained a controlling interest through a contract to do a certain amount of development work. The crosscut from the Black Rock shaft has gone through the Sellers and into the Florence claim, and is now being extended for the purpose of developing the Pollock.

New Federal Tax on Copper Production—Mining, business and labor circles in Butte are thoroughly aroused over the proposed Federal tax on the copper industry, incorporated in the bill that has just passed the House of Representatives at Washington, in spite of all efforts of Montana representatives to get this body to deal with the subject on its merits. Having failed in their attempt, Montana senators propose to make a vigorous fight to bring about the elimination of the tax on copper from the Kitchin revenue bill when it comes up for consideration by the Senate. The merits of the bill and its effect upon the copper and other industries of the state form the foremost topic of conversation among Montana mining men. It is held that the passage of such a measure would be a staggering blow to Montana mining; that the tax on gross receipts for copper would not only be a heavy burden, but that the terms of the tax would be inequitable, unjust and unfair. It would hit particularly hard Butte's larger mining companies. At current prices, the tax imposed upon the Anaconda company alone would be approximately $3,000,000 a year, an increase of more than seven times the present Federal income tax. Upon a normal copper market the tax would amount to more than 10% of the total net income of the company. While all the copper companies operating in Montana and particularly in Butte are willing to bear their share of any burden of taxation levied by the Federal government, they want to see the levy laid in equity and so devised as to reach all the country's industries that are properly classed in the group which includes the production of copper. As the proposed bill reads now, the discrimination against copper is so manifest that Montana's citizens will make every effort in their power to prevent the final passage of such a bill. Emphatic protests were sent to Washington by business and trade organizations and by citizens generally in many Montana communities, and Montana's men in the House of Representatives and in the Senate were instructed to use their utmost endeavors to have this heavy burden, threatening Montana's copper-mining industry, eliminated from the measure now pending in the Senate.

DENVER—July 13

Roosevelt Tunnel Heading, in the Cripple Creek district, is again being pushed, after about a month's cessation of work at the breast while the large station at the Elkton shaft and the sump were being excavated and timbered. The breast is now about on the line between the Ramona and the Crank lode claims northwest of the Elkton.

Drainage of the Fryer Hill Section, Leadville, undertaken by the United States Smelting, Refining and Mining Co., through the Harvard shaft, is accomplished. Sampling of the old mine workings is being done by Carl Allen, mining engineer. Extensive development will be undertaken at once. This is the second important drainage project to have attained its purpose this season, and the benefit to the district will be marked.

The American Coal Refining Co., which erected a plant in Denver during the last two years to handle 500 tons of raw lignite per day, has decided to proceed immediately with the doubling of its plant. The coal is crushed to 1 in. before being charged into air-tight rectangular ovens wherein it is subjected to ordinary distillation for about 2½ hr. at a temperature rising gradually from normal to 500° C. The volatiles pass through the usual types of collectors, scrubbers, etc., and are finally reduced to commercial forms of ammonia, creosote, tar, toluol and various grades of oil for flotation use. The residue remaining in the ovens after distillation is the fixed carbon with any ash or other non-volatiles in the raw coal. This residue is, to ordinary visual test, exactly like the original lignite, but its specific gravity is markedly less. It is next ground to ¼ in. in a ball mill mixed with some of the tar previously extracted as well as a dry substance the identity of which is a trade secret, and finally manufactured into a form of briquette to which the trade name of "carbonets" has been given. These are remarkably permanent in character and withstand both rough handling and weathering and, when burned in a furnace, retain their shape until actually consumed. Charles O. Hoover is chief engineer as well as manager of the company.

SALT LAKE CITY—July 14

A New Catalog of Utah Minerals and mining districts, prepared by Maynard Bixby, has just been issued by R. H. Officer & Co., assayers and chemists, of Salt Lake. The different counties of the state are taken up, and under them the various kinds of minerals found in each. There is a descriptive list of minerals and notes for collectors. This is the fourth edition of the booklet, which has been enlarged and revised.

The Output of the Gilsonite Mines near Duchesne for the first half of 1916 has been heavier than for the corresponding period last year, when the total output was 35,000 tons. The properties operating are the Rainbow, Temple, Country Boy, Big Bonanza and the Duchesne mine. The Castle Peak property has been taken over by Denver interests. About 120 men are employed in the five properties operating. Experiments are being made by the U. S. Geological Survey with the oil-bearing shales of the Uinta basin and have demonstrated that these shales will yield a good percentage of oil. The oil-bearing shales are 18 ft. thick and occur over an area 175 mi. long by 50 to 60 mi. wide.

Utah Operators Are Protesting against the tax on copper as set forth in the proposed revenue act, and Utah delegates in the Senate and in Congress are being urged to use every effort to defeat the measure. It is felt that the singling out of copper is an unjust discrimination, inasmuch as such a tax would cause copper-producing sections—a relatively small area—to carry a disproportionate amount of the whole taxation. The proposed new law would place a tax of 1% on copper output from $25,000 to $1,000,000, 2% from $1,000,000 to $10,000,000 and 3% on more than $10,000,000. Operators at present are paying 6 to 7% of the taxes in this state. The Utah chapter of the American Mining Congress and individuals have made protests. R. C. Gemmell, of the Utah Copper Co., in a telegram to Senator Smoot, points out that such a tax on copper would mean an output tax for the first time in the history of the country, and draws attention to the fact that

other industries besides copper (wheat, cotton, steel, etc.) have enjoyed extraordinary prosperity on account of the war. He urges that systems of taxation should not be based on temporary conditions, but upon broad and universal principles, and that the basis of all taxation should be a just and equitable distribution of the burdens of government among those benefited, the proposed tax being class legislation affecting only seven states—Arizona, California, Michigan, Montana, Nevada, New Mexico and Utah. It is mentioned that, due to the increased price of copper, wages have been raised three times, so that employees have benefited, and also that since the war began materials used by mining companies have advanced from 25 to 300%. Many millions of dollars have been invested in copper-mining properties, and in some cases millions have been invested without any return as yet to the investors. The prosperity of the seven states mentioned and the welfare of the inhabitants of these states would be disastrously affected if this unjust tax should become a law. Copper prices for the 10 years prior to 1915 averaged 13¼c. per lb., while the average cost of producing copper is close to 11c. per lb. At the beginning of the war and for six months subsequent thereto, copper companies were operating on a 50% basis, and many of them were losing instead of making money in an effort to keep their plants going and their men employed. At this time copper was selling at 11 or 12c. per lb. The proposed tax would seriously retard the electrification of railroads, would affect every telephone, telegraph and electric light company and, in ordinary times, would put many copper companies operating on a close margin out of business.

DOUGLAS, ARIZ.—July 14

Reopening Sonora Mines was discussed at a meeting of managers of mines in Sonora, including J. S. Williams, Jr., of the Moctezuma Copper Co., George Kingdon, of the Cananea Consolidated Copper Co., L. R. Budrow, of the El Tigre company, and Gen. P. Elias Calles, military governor of Sonora. General Calles stated that he had ordered his volunteer army demobilized and invited the managers to return to Sonora and reopen their mines, assuring them personal safety and protection for their properties. This the managers stated they were willing to do, providing the embargo on explosives is lifted or modified, but to return without being able to import explosives, they said, would be useless, as most of the companies have only enough dynamite on hand to last them a week or so. And some of this supply was confiscated by Gen. Calles' army when the war talk was strongest. Still some of the employees have already gone back and others are making preparations to return, hoping that the embargo will be raised within a few days Gilbert Melcher, superintendent of the Washington mine at Huepec, Harry Brown, superintendent of the Catalina mine at Cananea, nine foremen of the Moctezuma at Nacozari, and others have already gone south.

OATMAN, ARIZ.—July 10

The Main Activity of This Camp is still confined to the southern portion; in fact, practically the entire development of the camp, if the big mines be eliminated, is confined to this end. Perhaps the property that is making the most improvement is the Oatman Pioneer, and this is noteworthy as the company is a close corporation with not a share of stock for sale, so does its work quietly and is somewhat adverse to publicity. The main development in this property is confined to the 400 level, where both drifts are being extended with crosscuts. In the south drift crosscuts have been run both east and west. The east crosscut picked up the orebody after a fault and is now extended about 8 ft. in the ore and shows a face of about 4 ft. The orebody in the west drift is now thought to be from a different vein, known on the Arizona Tom Reed as the Snowball. The crosscut is now 16 ft. in this ore and has not struck the other wall. It shows a different trend from the main vein, coming more from the south. With the discovery of these two orebodies this property has become a center of interest in this part of the district.

JOPLIN—July 15

Curtailment in Output to the extent of 1,000 tons weekly has been brought about by closing down of numerous mines. Accident at plant of local electrical company partly responsible but a number of the mines are working ore faces too thin to return a profit with ore below $80 a ton. Nine of the principal producers of the West Joplin sheet-ground camp are down, and four or five of the big producers of North Webb City. A number of the larger mines in the Oklahoma camp also are down.

Two Important Mining Deals were recently consummated in this district. The Quick Seven and three other properties at Neck City were sold for $129,500 to the Missouri Zinc Mines Co., composed of Minnesota and North Dakota men, and the Princeton mine at Carthage was sold for $60,000 by Drake, Stone and associates to Ball & Hardy, of Webb City. The Quick Seven was opened in 1908 and produced over 37,000,000 lb. of high-grade blende; and the other mines, the Nineteen Nine, the Tessie M and the Texmo, have all been good producers; three concentrating plants are included in the deal.

Furnaces Were Lighted at the Fort Smith Spelter Co.'s new plant at South Fort Smith during the last week, when connection was made with the natural-gas field at Clear Creek, and blocks Nos. 2 and 3 will be charged in a day or two. Connections also was made with the city water mains last week; delay in getting this done has caused the starting of the smeltery later than had been expected. The new plant has four blocks, 640 retorts to the block; construction was started about Mar. 1. The company is a subsidiary of the Trumbull Steel Co., of Warren, Ohio.

DULUTH, MINN.—July 15

The Strike Is on the Wane on the Mesabi range; many miners have deserted the ranks of the I. W. W. and are returning to their places, a number of mines having resumed operation. This week the North Eddy, Laura, Utica and Albany properties started mining again, after being closed down for a month. Other underground mines will shortly commence work again. No new agitators have arrived on the range to take the places of those who are in the St. Louis county jail, in Duluth, charged with murder, and it is believed that it is useless to continue the fight. There were a number of arrests for picketing and intimidation this week, some strikers being taken into custody in Chisholm and others in Nashwauk. The few strikers who are trying to save the day seem to have lost heart and thus far no strike benefits have been paid to the men, although they were promised a certain amount each week. Pit properties are still working to capacity and there is no let-up in the movement of ore from the mines to the docks. The stockpiles are supplying their share, every shovel on the range now being in operation. Some underground mines will not be opened again this year, as the operators can get enough ore otherwise to fill their contracts.

TORONTO—July 14

New Gold Strike on Wells Claim, near Tashota station, is reported by Percy E. Hopkins, assistant provincial geologist of Ontario, who is making an examination of the Tashota district. The discovery is on location T. B. 2892, 2 mi. east of Tashota station and ¼ mi. south of the railroad. The ore is rich in free gold, one piece being as large as a pea. The Devanny claim is being actively developed and work is shortly to be resumed on the King Dodds claim in the Kowkash area.

Absolute Prohibition of Nickel Exports has made much headway since the announcement that the German merchant submarine "Deutschland" was about to ship a cargo of nickel at Baltimore. The belief is general and widespread that the nickel must be the product of Canadian matte refined by the International Nickel Co., and the Canadian government is being denounced by journals of all shades of opinion for its nickel policy. The result of a by-election in North Perth, Ont., where a Conservative majority of 1,117 at the previous election, was converted into a Liberal majority of 627, is quoted as an evidence of the popular sentiment on the question, but too much importance should not be attached to it as other issues were involved, though the nickel question undoubtedly had some influence on the result. The Canadian government has endeavored to reassure the public by the issue of an official statement repeating what has been said on former occasions as to the measures taken early in the war to prevent the export of Canadian nickel to Germany with the full approval of the British government which regards these precautions as sufficient. The allegation that the nickel secured by the Germans is from Canadian mines, is based upon the statement that no nickel is refined in the United States except what is derived from Canada. That this is a misconception is shown by the following report from Major Graham A. Bell, who has had the duty of examining and supervising the destination of nickel refined in the United States from Canadian ore:

There is a considerable quantity of nickel ore obtained through various copper mines in the United States, and this ore is refined principally by the American Smelting and Refining Co. There is also nickel ore obtained from New Caledonia, which is refined by the United States Nickel Co., of New Brunswick, N. J. The quantity, of course, does not compare with the tonnage manufactured from Canadian ores, but there are some hundreds of tons of refined nickel produced yearly from these sources.

The possibility of the Germans obtaining nickel manufactured from Canadian ore is also strenuously denied by Hon. G. Howard Ferguson, Ontario Minister of Mines. He further states that the Provincial Government has in view the establishment of a nickel-refining industry, having secured patents for two processes, one of which is electric. A large sum of money has been spent by the government in testing these processes which, having been proved successful in the laboratory, are now being tested on a commercial scale.

The Mining News

ARIZONA

Cochise County

REPUBLIC (Johnson)—Has installed Sullivan sharpener and Case oil forge for heating steel.

COPPER CHIEF (Johnson)—New 200-hp. oil-burning boiler and steam hoist being installed to supplant gasoline power, after which will increase output.

RED BIRD (Cochise)—Gold ore struck at 150 ft.; San Antonio men operating as Cochise Mining and Milling Co. have bonded mine and are working two shifts. Mine only 3 mi. from S. P. station.

Gila County

IRON CAP (Globe)—Struck good ore recently on 900-ft. level; ore heretofore came from 800-ft. level and up; enlarging surface equipment and Iron Cap shaft from collar to 600-ft. level.

INSPIRATION NEEDLES COPPER (Miami)—Grading roads for churn drill machines and erecting camp buildings. Hole No. 1 reported in ore for 55 ft.; pipe water from Southwestern Miami property for the churn drills. John S. Cook, of Nevada, interested. New York office, 110 Nassau St.

Mohave County

OATMAN CRESCENT (Oatman)—Tunnel now in over 200 ft.; making about 10 ft. daily.

TOM REED (Oatman)—Sinking both in Red Cloud and Grey Eagle shafts; last week 50 ft. was made. All 20 stamps again dropping, crushing 140 tons daily.

ARIZONA TOM REED (Oatman)—Drills will be added for sinking the main shaft, air for the drills being piped from the Oatman Pioneer. George Moser, superintendent.

BIG JIM (Oatman)—East drift on 400 level driven 57 ft. and west drift 31 ft.; the east drift on 500 level is 108 and west drift 37 ft. All reported in good ore. An average of $28.56 shown by 5-ft. samples in the 80 ft. of drifts on the 400 level.

CHLORIDE MINING (Chloride)—F. C. Smith has interested O. B. Willcox and associates, of 14 Wall St., New York, in development of this property; Hidden Treasure also included in the deal.

BLACK RANGE (Oatman)—Inclined shaft will be abandoned and new three-compartment shaft started 442 ft. northeast; expected to cut vein at 620 ft. The 60-hp. Western hoist will be moved to new site but compressors will remain at old shaft. A minimum of $4,000 per month is to be spent under new arrangement with E. McNeal & Co. Charles Arkins, consulting engineer.

Yavapai County

MINGUS COPPER (Jerome)—Will resume operations at once; W. W. Thomas, manager; situated in Copper Chief district.

STODDARD MILLING CO. (Stoddard)—Concrete walls and foundations for 100-ton flotation plant completed; 10 carloads machinery at Mayer. Expect to start mill early in August.

PITTSBURGH-JEROME (Jerome)—Building 2-mi. road to property; will install new compressor and other heavy machinery; electric power will supplant gasoline; 2-mi. transmission line will be built.

COMMERCIAL (Skull Valley)—W. Tovote, of Bisbee, representing the Phelps-Dodge interests, is examining property to ascertain advisability of constructing 6-mi. railroad from Skull Valley, and erecting leaching plant.

GREEN MONSTER (Jerome)—Preparing to sink two-compartment shaft 1,000 ft. on the Brad claim; will be equipped with electric hoist, compressor and 12 drills. The 3,000-ft. road for delivery of machinery to be completed by August.

CALIFORNIA

Amador County

TREASURE (Amador City)—New mill started first week in July.

KENNEDY (Jackson)—Preparing to sink the vertical shaft to the 4,400-ft. point and to make a station at the 4,000 level.

PLYMOUTH CONSOLIDATED (Plymouth) — William Saraba, skip tender, was killed by falling into shaft on July 1.

ARGONAUT (Jackson)—Construction of new mill well under way. Old 40-stamp mill east of shaft will continue in steady operation, until part of old machinery is required in new plant.

CONSOLIDATED AMADOR (Sutter Creek)—Progress of 20 ft. per day in unwatering and repairing Old Eureka shaft. Water now 240 ft. below collar. Many shaft timbers found in excellent condition.

Butte County

MANGANESE DEPOSITS being actively prospected in vicinity of Clipper mills. At Binet property developing to open extension of the Bear Cañon's orebody. A. A. Davis and T. F. Hornung have uncovered promising ore and are sinking a shaft. High-grade ore shipped to Heroult electric smeltery in Shasta County.

Calaveras County

EASY BIRD (Mokelumne Hill)—Installing compressor and electric hoist; may erect 75-ton electric-driven mill. Ore stated to average about $9 per ton. Three-compartment shaft contemplated. Now operated by Mokelumne Mines Co., controlled by Los Angeles men.

Inyo County

TUNGSTEN MINES ARE ACTIVE at Bishop. Tungsten Mines Co. milling plant rapidly nearing completion. Development recently disclosed additional ore deposits. Locomobile engine being installed on truck for hauling ore cars from the portal of the tunnel, a distance of 1,700 ft. to the mill. Standard company has its 50-ton mill completed and will increase it to 100 tons; bucket tramway will be installed.

CERRO GORDO (Keeler)—Will soon be shipping 500 tons per month. The 8-mi. aërial tramway delivering ore from the mine to Keeler is operating regularly. New assay offices being completed.

Kern County

RANDSBURG-ATOLIA TUNGSTEN PRODUCERS' ASSOCIATION, formed by owners and operators in Randsburg-Atolia districts, held second meeting July 1, and elected following officers and directors: P. J. Osdick, president; A. M. Sweeney, secretary; J. A. Waltman, Val Schmidt, U. S. G. Todd, W. L. Jones, Robert Gunderson, T. W. Sanborn, directors.

PAGE (Randsburg)—Property in Stringer district recently purchased by Roschl, Lawrence, Coleburn, Illingworth and Davis. Equipment of tanks, hoists, ore bins, etc., being installed. Reported that gravel carries from 5 to 100 lb. of high-grade tungsten concentrates to the ton and $10 to $20 in gold. Will be worked through large sluice box; fines amalgamated. Water will be furnished from 21,000-gal. tanks filled from water cars on the Osdick siding. There are 5 full claims and a fraction. Bedrock at 5 to 20 ft.

Shasta County

MOUNTAIN COPPER (Keswick)—Three men killed and three injured by explosion of acetylene welding apparatus.

Sierra County

PLUMBAGO (Alleghany)—Another bonanza strike reported. Five stamps being added to 20-stamp mill. W. B. Pearson, superintendent.

SOVEREIGN (Sierra City)—Bonded to Lowe and Mitchell, of Denver; developing in Nevada tunnel, and overhauling machinery. G. D. Bodfish in charge.

ROCK CREEK (Downieville)—Long payshoot showing free gold ready for stoping. Ten-stamp mill and rock crusher being installed. Dolan & Bell, own and operate.

MORNING GLORY (Alleghany)—More bonanza ore encountered; reserves being increased. Air compressor, hoist and five-stamp mill to be installed. John Marthaler, superintendent.

MONARCH (Sierra City)—Purchased Ladies Cañon gravel mine, crossed by Monarch ledge, and will run lower tunnel to tap, 150 ft. below bottom of present shaft. D. McGonigal, manager.

COLORADO

Boulder County

LUCKIE 2 TUNGSTEN CO. (Boulder)—Completed its 30-ton concentrating mill, July 1.

SUN TUNGSTEN MINING CO. (Boulder)—New organization will operate the Lucille properties.

U. S. TUNGSTEN CO. (Boulder)—Has acquired holdings of Colorado Tungsten Co., including mill at Nederland.

TUNGSTEN METALS CORPORATION (Boulder)—Developing the Red Sign No. 2 and Ferberite properties. Mill under construction.

TUNGSTEN GIRL MINING CO. (Ward)—Organized by Joseph Conners and associates of Denver to take over Blue Bird and Burnt Mountain properties near Ward.

BOULDER-GILPIN TUNGSTEN MINING CO. (Boulder)—Has acquired 100 acres; operations will be carried on through Walter shaft. N. H. Brown, general manager.

EAGLE ROCK TUNGSTEN PRODUCTION CO. (Eagle Rock)—Mill being increased to 75 tons and will handle custom ore. Developing 150 acres of company ground.

GRIMM MILL (Boulder Cañon)—New 40-ton mill being built by S. A. Grimm and son at God Cliff; cost, $10,000. Mill will be operated by electricity and will treat ore from Chappell and neighboring properties.

DEGGE-CLARK MILL (Boulder Cañon)—About 30 men at work completing this 100-ton plant. Mill bins holding 400 tons now full of ore. Company owns the Brace tungsten tract of 320 acres in Beaver Creek district where 12 sets of lessees are at work.

VICTOR TUNGSTEN CO. (Nederland) — Developing property adjoining the Wolf Tongue. Drifting on vein at depth of 125 ft. Hoisting and compressor equipment will be installed capable of sinking to 1,000 ft. M. B. Rapp, of Cripple Creek, general manager.

PRIMOS (Lakewood)—Many leasers and prospectors have left recently on account of the relatively low price of tungsten. About 200 men are still at work on leases in and about the company's properties. Many of these are working over old dumps. New set of rolls being installed in Lakewood plant to replace some of the stamps.

CARIBOU MINES & MILLS CO. (Cardinal)—About 60 men are at work, two shifts being worked at mine and three in mill. Many surface improvements recently made, including new assay office and bunkhouse. The 1,000-ft. shaft is equipped with a 75-hp. electric hoist; surface bins have ca-

pacity of 350 tons. A 100-hp. compressor supplies air for drilling. Ore treated at 125-ton mill now running at capacity. Milling equipment includes a 10x16-in. Blake crusher, 16x36-in. rolls, one 6-ft. Hardinge mill, one 4.5-ft. Hardinge mill, one 5x5-ft. regrinding mill, classifiers, six concentrating tables, and a two-unit 12-cell flotation plant.

Park County

HOCK HOCKING (Alma)—A 10-stamp mill is being erected. George W. Logan, Denver, principal owner.

San Juan County

SHIPMENTS of crude ore and concentrates from Silverton during month of June were: Sunnyside, 42 cars; S. D. & G. Lease, 16; Gold King, 14; Iowa Tiger, 13; Dives Leasing Co., 10; Kittimac, 3; Davey Leasing Co., 3; North Star, 2; St. Paul, 2; Big Giant, Dora, Sultana, and Andrew Jackson Lease, 1 car each; miscellaneous, 5; total, 114 cars.

BIG GIANT (Silverton)—Ore treated in Contention mill.

GALENA MOUNTAIN GOLD AND SILVER CO. (Silverton)—Development to be resumed.

KITTIMAC (Eureka)—Forest fire destroyed five towers of tramway, resulting in shut down of about two weeks in mill.

HAMLET (Silverton)—New mill nearing completion; will contain flotation and electrostatic zinc-separating equipment.

Summit County

MUDDY (Breckenridge)—This Galena Gulch mine bonded by Kansas City men.

GOVERNOR (Breckenridge)—Reopening this old silver mine on upper Blue River, 8 mi. south of Breckenridge. Concentrating plant at mine.

DUNKIN (Breckenridge)—Lessees shipped 27 tons to Globe smelting plant, Denver, netting $30,000. Free gold in coarse flakes is found in mine; separated and shipped to mint.

Teller County

AJAX (Victor)—During June ten sets of lessees produced 586 tons; average value $18. Experiments in flotation in progress at mill.

ANNIE P. MINING CO. (Victor)—Developing First Chance property on Mineral Hill. Steam hoist installed. Seepage water is being bailed from shaft.

EL PASO (Victor)—Lessees opened new orebodies in old workings near surface. Daily production varies from 65 to 100 tons, value from $20 to $30 a ton.

ROSE NICHOL (Victor)—Ed Gaylord and associates have five-year lease; main shaft and adjacent workings cleared of tailings, which ran in from the Victor mill, and active development resumed.

GOLD SOVEREIGN (Victor)—First shipment of bullion made from Reed mill on the Dante. Now treating from 45 to 50 tons daily of dump ore from Gold Sovereign mine; ore averages from $3 to $4 a ton; estimate 90% saving.

PUZZLE (Cripple Creek)—This property on western slope of Gold Hill being developed through Ophelia tunnel by Thomas Tibbetts, of Cripple Creek. Drifting on 3-ft. vein containing 10-in. streak running about 1 oz. gold, 10 oz. silver and 12% lead.

IDAHO

Shoshone County

NATIONAL COPPER MINING CO. (Mullan)—Ore too low grade to pay. Mine and mill closed. Charles McKinnis, Wallace, secretary.

STEWART (Kellogg)—Company doubled capital stock on July 8 and will explore other fields, local mine being practically exhausted. Two properties in Nevada, examined by Supt. William A. Beaudry, will probably be taken over. Three Idaho properties now being examined.

GEORGIA

MARIETTA MINING CO. (Marietta)—Incorporated by Houston & Liggett, of Lewisburg, Tenn., to operate pyrite deposit near here. Equipment for 50-ton operation purchased from Allis-Chalmers Manufacturing Co. of Milwaukee, Wis.

MICHIGAN

Iron

PURITAN (Ironwood)—New steel headframe to be erected. New idlers also to be put in. Shaft house will be 90 ft. high; American Bridge Co. has contract.

HOLMES (Ishpeming)—Foundations being put in for steel headframe, 142 ft. high, highest in district. There will be two crushers; now on ground. Shaft now down over 500 ft.; will go to 950 ft.

DOBER (Iron River)—Residents have protested to Oliver Iron Mining Co. about fumes from sulphide fire burning underground for several months. It has been decided to flood the workings; ditch being dug to mine from Iron River.

ASHLAND (Ironwood)—Mining will be discontinued in a few weeks. Deposits are about worked out. Effort to locate more ore unsuccessfull so far. About 250 men working. Has been producing, with only a few stops, since 1884. Operated by Hayes Bros.

HANOUSEK (Wakefield)—Stripping completed across one 40-acre tract. About 900,000 tons of overburden removed; 315-ton Bucyrus shovel being used. Shovel works on face 40 ft. high; can work up to 50 ft.; loads cars on tracks 40 ft. above level of steam-shovel track. Some ore may be shipped this year.

MINNESOTA

Mesabi Range

HILL (Marble)—Three shovels engaged in this openpit development.

HOLMAN (Taconite)—Drainage shaft now nearing completion. Two shovels stripping.

ARCTURUS (Marble)—One shovel stripping at this mine. Less work than was carried on last winter.

JUDD (Holman)—This small openpit property shipped 50,000 tons this season but is now closed.

TROUT LAKE CONCENTRATOR (Coleraine)—This Oliver washery is operating four units on day shift and two at night—about 60% of capacity. The five units are capable of handling 40,000 tons in 24 hr.

CANISTEO (Coleraine)—Stripping at east side of pit. Four shovels mining ore, largely of wash quality. Pit about 3,400 ft. long by 2,500 ft. across; greatest depth, 225 ft. Mine one of largest producers on the Mesabi.

MISSOURI

MISSISSIPPI VALLEY IRON CO. (St. Louis)—Has completed its blast furnace at Broadway and Soper St. and 100,000 tons of Mesabi ore is being received pending shipments from company's mines at Waukon, Iowa. Docks at foot of Kansas St. About 500 men employed.

Joplin District

CAVE-IN at Babcock mine on July 17 imprisoned four men, 40 ft. from shaft, for about 40 hr.

AT PEACOCK CAMP dike completed, protecting against floods, 1,200 ft. in length, 15 ft. high. New mill of Childress & Sheldon well under way. Three centrifugal pumps have drained water to depth of 80 ft.

MARY C (Prosperity)—New mill of Breigel-Conklin interests started.

WALKER (Commerce, Okla.)—New mill about completed. Ore from 142 to 160 ft.

MAHATMA (Prosperity)—New mill started by Hornbrook & Federman. Ore from 40 to 200 ft. Upper level being worked first.

MERCHANTS (Commerce, Okla.)—Two good drill strikes on Jarrett land, 4 mi. north. Second hole showed over 70 ft. of ore.

CUMBERLAND (Prosperity)—Record for mill building made by F. C. Wallower in this plant, which replaces one burned in May. Mill erected and started in 39 days. Capacity 500 tons per 10-hr. shift. Twelve slime tables. Electrically operated throughout.

MONTANA

Fergus County

BARNES KING (Kendall)—June report states little gold was produced due to shutdowns, necessary to prepare for increased output. At North Moccasin, plant was closed from June 15 to July 1; during first half of June treated 945 tons of ore, yielding $7,800 or $8.25 per ton. At Piegan-Gloster, in Lewis and Clark County, mill operated eight days and shut down without a cleanup; 700 tons treated. At Shannon mine, delay caused by bad weather and slow delivery of construction material. At Woodrow Wilson in Rimini district, 105 ft. of tunnels were driven.

Silver Bow County

EAST BUTTE (Butte)—Pushing development work on 1,800; will sink to the 2,000 level. High-grade ore on 1,500 level; average ore from mine now about 4% copper.

BUTTE & ZENITH CITY (Butte)—Shaft now down 830 ft. but going rather slowly owing to hard rock. Company expects to reach 1,000-ft. level in three months. Pump installed at 800-ft. level.

BUTTE & BACORN (Butte)—Will install new steam hoisting plant for depth of 1,500 ft., and two boilers of 150 hp. capacity each. Calumet shaft will be sunk from 1,000- to 1,500-ft. level.

DAVIS-DALY (Butte)—New hoisting engine for Colorado mine on its way to Butte; of Nordberg type, able to hoist from depth of 4,000 ft. with capacity of over 1,000 tons in 16 hr. from that depth. Management expects to have engine in operation by September.

NORTH BUTTE (Butte)—June production largest in past year. With both Granite-Mountain and Speculator shafts in use total tonnage for month was 44,136 tons, about 1,500 tons per day. Realized 2,096,326 lb. copper, 90,713 oz. silver and 142.23 oz. gold.

ANACONDA (Butte)—Heavy rains reduced deliveries to Great Falls reduction plant in June, making total output of company fall 1,900,000 lb. below May production. Total June output was 28,100,000 lb. Nettie mine in extreme western section of Butte camp shipping about 50 tons daily of rich silver ore from 500 level; carries some zinc; between 20,000 and 40,000 tons blocked out. Company has let contract for sinking Nettie shaft from 500 to 1,500 level.

BUTTE & SUPERIOR MINING CO. (Butte)—June output slightly less than in May; milled 52,600 tons from which 14,400 tons of zinc concentrates and 540 tons of lead concentrates were secured. Zinc realized amounted to 15,200,000 lb.; recovery approximately 94%. Silver production 310,000 oz. A verdict for $177,704 in favor of Elm Orlu Mining Co. against Butte & Superior was rendered July 2 by Federal Judge Bourquin for ore taken by Butte & Superior from Elm Orlu ground prior to starting suit.

NEVADA

Esmeralda County

MUCKING CONTEST at Goldfield, July 4 and 5, was won by Finnish shovelers. Two tons of assorted rock, ranging in size from 3 to 6 in. in diameter, was placed in a box 6 ft. long by 30 in. deep by 30 in. wide. Shoveler was thus compelled to begin on top of pile and in most cases nearly two-thirds of the rock was removed before bottom was uncovered enough to permit the use of a square-pointed shovel. Twenty-four entries competed for the prizes of $100, $50 and $25, the winning time being 19 min. and 51 sec., just 3 min. better than second place and 10 min. less than the slowest time.

Humboldt County

RAGGED TOP MINES (Jessup)—Tungsten property in Trinity Mountains about 20 miles south of Lovelocks; 35 men employed. Shipping about 20 tons per day to leased mill in Utah where test is being made to determine equipment for local plant.

ROCHESTER MINES (Rochester)—Has resumed sinking Codd winze; south drift on West vein still in ore; in north-end workings good results continue to be obtained. Work begun on foundations for machinery doubling capacity of mill.

SEVEN TROUGHS COALITION (Seven Troughs)—Breaking 8 in .of high-grade ore in north drift on 1,660-ft. or "1700" level; in south drift shoot is low grade. New Chicago Pneumatic 395-cu.ft. air compressor now being installed will double air supply and expedite development planned.

Lincoln County

PRINCE CONSOLIDATED (Pioche)—Shipping about 65 cars per week.

CONSOLIDATED NEVADA-UTAH (Pioche)—Mill operating regularly at capacity of about 60 tons per day; mainly on dump material. New crosscut started from 1,400-ft. level, No. 1 shaft, to prospect west of Black Ledge winze.

Nye County

TONOPAH ORE PRODUCTION for week ended July 8 was 8,038 tons, valued at $170,764, compared with 9,043 tons for week previous. Producers were: Tonopah Extension, 2,200 tons; Tonopah Belmont, 2,115; Tonopah Mining, 2,000; West End, 605; Jim Butler, 600; Halifax, 181; Rescue-Eula, 159; miscellaneous, 126 tons.

WEST END (Tonopah)—On July 3, Supreme Court of Nevada affirmed decision of lower court in the "apex" suit in favor of this company; suit was brought by the Jim Butler.

CALIFORNIA-TONOPAH (Tonopah)—Tonopah Mining Co., which has been actively developing property since December, has relinquished option. Some ore shipped from above 300-ft. level.

Storey County

ALPHA AND EXCHEQUER (Virginia)—On 200 level, Imperial shaft, extracted 34 cars low-grade ore.

ANDES (Virginia)—Saved 16 cars of ore from development on 350 level; completed a run of 140 tons of ore at the Kinkead mill.

MEXICAN (Virginia)—South drift from west crosscut advanced 10 ft., face in porphyry. Alterations continued in winze station on 2,700 level. Mexican mill received 392 tons custom ore, averaging $36.43 per ton.

CROWN POINT-BELCHER (Gold Hill)—Prospecting continued on 300 level; 46 cars of ore saved. Electric equipment from lower levels taken to the surface and being overhauled. Repairs made to Jacket shaft and incline. Jacket mill received 790 tons dump rock.

UNION CON. (Virginia)—Ore extraction totaled 392 tons; value over $14,000. From 2,400 level 207 tons, $50.06; 2,500 level 64 tons, $18.70, and 120 tons, $14.51. Reopened northeast drift, 2,500 level, 50 ft. Repairs continued in Sierra Nevada-Union 2,500-2,900 winze. Union shaft reopened from 143-ft. point to 155-ft. point below 2,500 level and repairs continued to 2,400 and 2,500 stations.

PENNSYLVANIA

BETHLEHEM STEEL (South Bethlehem)—New appropriation of $70,000,000 for enlargement of plants, during next three years, expected to be applied mainly to Sparrows Point, Md., Steelton and South Bethlehem.

UTAH

Juab County

TINTIC SHIPMENTS for first six months of year amounted to 4,211 cars, estimated at 219,550 tons. During June there were shipped 1,069 cars.

CHIEF CONSOLIDATED (Eureka)—June shipments amounted to 221 cars.

IRON BLOSSOM (Silver City)—In June shipped 100 cars; net profit stated to have been $30,000. Approximately $325,000 in treasury.

TINTIC MILLING (Silver City)—Additional Holt-Dern roasters ordered will not be completed before 90 days, owing to manufacturing delays. Excavation finished and concrete work is in progress. Mill capacity at present 100 tons daily, with three Holt-Dern roasters; to be increased to 360 tons.

Salt Lake County

ORE HAULING IN BIG COTTONWOOD is to be done by five caterpillars and sixty trailers, in place of teams. The Cardiff will furnish most of the ore. Hauling is in charge of Abe Meeking, Jr., and C. S. Austin.

NEW UTAH BINGHAM (Bingham)—Marsden lease shipped 52 tons, averaging 13.7 oz. Ag, 36.9% Pb, 15.6 SiO_2, 14.6 S and 15.3 Fe; average value, $46.72; treatment cost, $5.44; freight and hauling, $2; net returns, less sampling, $38.15 per ton.

SOUTH HECLA (Alta)—Dividend No. 1 of 15c. a share, amounting to $40,000, has been declared payable Aug. 10, and a good surplus remains in the treasury. During the last two weeks in June approximately 700 tons of ore, valued at $15,000, was shipped.

UTAH COPPER (Bingham)—Production and earnings for the first six months of 1916 amounted to 85,000,000 lb. and $17,250,000, as compared to $6,525,000 for the first half of 1915. A new record of production was made on July 9 when 44,000 tons of ore was handled in 24 hr., as well as 25,000 tons of overburden. June production is estimated at 17,500,000 lb. or greater.

Summit County

PARK CITY SHIPMENTS for June amounted to 8,714 tons. Those for the week ended July 7 were 1,229 tons, as compared with 1,413 tons the week preceding, the falling off having been due to the Fourth of July holiday.

DALY-JUDGE EXTENSION (Park City)—Gasoline hoist to be installed preparatory to beginning work.

DALY (Park City)—Shipments are being made both by company and lessees. Including latter there are about 70 men employed.

SILVER KING CONSOLIDATED (Park City)—Preliminary work begun on 14,000-ft. tunnel to prospect Thaynes Cañon section of property. Preparations being made to install new machinery in recently purchased Grasselli mill. Flotation as well as regular concentrating equipment will be used. Most of material for the 10,000-ft. aërial tramway is delivered.

WASHINGTON

Stevens County

WALTER J. NICHOLLS and associates of Spokane have acquired a group of claims on Gladstone Mountain, adjoining the Electric Point lead mine, near Northport.

ELECTRIC POINT (Northport)—A motor truck and 30 horses being used to transport ore to railroad at Boundary. Trail smelting plant has offered to take 100 tons daily if carbonate and galena are kept separate. No. 2 chimney proving better than the first.

CANADA

Ontario

RED JACKET (Cobalt)—Long idle; now being dewatered.

MALOUF (Sesekinika)—Half interest sold to Boston Creek operators.

TRETHEWEY (Cobalt)—Shipped two cars concentrates, first since mine was closed two years ago.

COBALT GEM—Company being wound up. Tenders asked up to July 21 for sale or lease of property.

TEMISKAMING (Cobalt)—A 14-in. vein, being opened on 500 level, is stated to carry 8,000-oz. ore.

ADANAC (Cobalt)—Control sold to Larkins and Sangster, of St. Catherines, Ont., and Buffalo, N. Y.

LAKE SHORE (Kirkland Lake)—Mine shut down to install larger plant. Rich ore in the new shoot on 300 level.

SYLVANITE (Kirkland Lake)—One of properties tied up in litigation is expected to resume work. New directors elected.

DOME LAKE (Porcupine)—Will again increase capital to pay off debt and enlarge mill. Developments stated to be satisfactory.

NIPISSING—During June $294,669 worth of ore was mined and bullion shipments from Nipissing and customs ore were estimated at $193,403.

RELIANCE (Cobalt)—Option held by the Peterson Lake will not be exercised. Some high-grade ore discovered but occurrence was spotty.

SCHUMACHER (Porcupine)—Net profits in June, $8,793; highest yet made. Reserves estimated at 64,900 tons, averaging $6. Costs for June were $3.80 a ton.

AUGARITA (Porcupine)—Recently organized to operate properties in Dome section. Has let contract for diamond drilling. Main vein stripped for 1,700 ft. William G. Barney in charge.

DOME MINES (Porcupine)—June production $179,000 from 36,700 tons of ore—an average recovery of $4.88. Operating costs $2.62 a ton. Record production in July expected, crushing capacity having been increased by new Hardinge mills.

INTERNATIONAL MOLYBDENUM (Renfrew)—Work begun on 100-ton molybdenum mill for the mines at Mount St. Patrick, Enterprise, Wakefield and Sudbury. Concentrates will for some time be sent to a refinery at Orillia, but as soon as electrical energy can be obtained, company will establish its own refinery.

HOLLINGER CONSOLIDATED (Porcupine)—Initial report since consolidation, period Jan. 1-June 16, shows profits of $1,261,900. Mill treated 263,356 tons, running 92.5% of possible time; average value of ore treated, $8.80 per ton; working cost, $3.36 per ton. Considerable delay obtaining apparatus for mill extension and not yet been able to bring capacity up to 1,900 tons per day. Output not quite sufficient as yet to meet dividend requirement of consolidated companies.

MEXICO

Hidalgo

SANTA GERTRUDIS (Pachuca)—Crushed 22,432 tons in May; estimated profit, £15,000; April profit, £24,450.

Mexico

ESPERANZA (El Oro)—Profit in 1915 was £28,700, from treatment of 22,684 tons. Reserves Jan. 1, 1916, 156,000 tons estimated to yield normally a profit of £109,000; tailings, 40,000 tons; estimated profit, £30,000. Milling started this year on small scale Apr. 22; foreign staff went to Mexico City during recent trouble, Mexican staff continuing to run mine and mill.

Sonora

CANANEA CONSOLIDATED (Cananea)—Remainder of American staff returned on July 17 and took charge of operations that had been continued by the native staff with only comparatively small curtailment of production, copper output for June being about 4,500,000 lb. Dynamite shipments passed when approved by President Wilson. Southern Pacific company has again taken charge of railroad.

PANAMA

SHIPMENT OF 1,000 TONS MANGANESE ORE recently made to New York from Madinga mine, Gulf of San Blas. From development previously mentioned; inability to get ships caused suspension of operation.

AUSTRALIA

GOLD PRODUCTION in Queensland in May was 27,797 oz. fine, a decrease of 2,872 oz. from May, 1915. For five months ended May 31, it was 107,304 oz. in 1915, and 99,893 oz. in 1916; decrease, 7,411 oz. this year. Quarter ended Mar. 31 production of minerals other than gold and coal was valued at £495,523, an increase of £205,203 over 1915. Copper increased £191,502 and tin £11,878 in value.

RUSSIA

IRON MINING CONCESSION granted for opening of new iron mines in Krivoi-Rog district in South Russia, near Zelionaia on the Kharkoff-Nikolaieff R.R. Concession covers 16,000 acres and is for 24 years on a royalty 0.9 kopek per pood—about 17c. per short ton—of ore taken out; minimum rental, 6,000 rubles yearly.

The Market Report

Metal Markets

NEW YORK—July 19

Copper continued very dull, but both in lead and in spelter there was a good deal more activity than in the previous week, and in spelter there was a sharp rally in price.

Henry R. Merton & Co., Ltd., of London, issued the following circular under date of July 1: "We beg to inform you that the shares in our company which were hitherto held by German firms have now all been acquired by British subjects. Negotiations were authorized and entered into as long ago as July, 1915, but only came to a successful conclusion early in February of this year. The terms of the transaction were submitted to the Board of Trade and High Court of Justice for their approval, which was granted. The company has altered its articles of association, which now contain very stringent provisions by virtue of which the company is now and will always remain under exclusively British control."

Copper, Tin, Lead and Zinc

Copper—On Thursday and Friday there were some fairly large sales of copper for export—September-October and September-November shipment—the business being taken at lower prices than had previously been quoted, but sellers welcomed the opportunity to do some business. Subsequent transactions, so far as reported to us, were small and quotations were more or less nominal. The noteworthy feature of the week was the request from a good many consumers for the deferral of shipment of copper bought for July and August delivery; or in the event of inability to arrange for postponement the offering of surplus copper for sale. The quantity of copper thus involved was considerable. Various reasons were assigned for this action, but the long and short of the matter was that several consumers had over-bought their July and August requirements. The readjustment of this condition naturally relieved the tension with respect to early deliveries from some selling quarters. On the other hand, in other quarters selling agencies found themselves still embarrassed in keeping up with their contracts. Consumers offered July-August copper at 24c., regular terms, but agencies were sellers at 23c. Transactions were light for the reason that nobody seemed to want early copper anyhow.

Copper Sheets are nominal at 37.5c. for hot rolled and 38.5c. for cold rolled. Copper wire is 29@30c. per lb. for large lots at mill.

Copper Exports from Baltimore for last week included 1,862,464 lb. copper and 351,573 lb. brass disks to Marseilles, France.

Visible Stocks of Copper in Europe on July 15 are reported as follows: Great Britain, 4,079; France, 3,385; afloat from Chile, 1,850; afloat from Australia, 3,500; total, 12,814 gross tons, or 28,703,660 lb. This is a decrease of 1,014 tons from the July 30 report.

Tin—This market was quiet, prices fluctuating from day to day in general conformity with the London market.

Tin Production covered by the statistics for the 12 months ended June 30, 1916, is estimated by Messrs. Ricard & Freiwald as follows: Straits, 64,531; Australia, 2,993; Banka and Billiton, 17,759; standard—chiefly Chinese—10,617; total, 95,900 long tons. Deliveries covered for the same period were: United States, 59,577; Great Britain, 19,071; Holland, 1,974; other Europe, 12,943; total, 93,565 long tons. These figures do not include South Africa, Nigeria, Bolivia or Cornwall.

Lead—A rather large business was reported—much larger than in the previous week—but conditions were considerably mixed. The price of the A. S. & R. Co. was undercut right along, and sellers who cut lost business to others who cut more. Missouri producers were cheap sellers. Late in the week the principal producer began to realize again its quoted price for desilverized lead.

The situation appears to be something like this: The statistical position is still excellent. Stocks are very low and are not accumulating, but producers are averse to allowing them to accumulate. Consequently, when buyers do not come forward, producers hunt them up and cut prices to get their business. On the other hand, when buyers are in need of lead for prompt delivery, or of a kind other than Missouri brands, they are likely to have to pay a stiffer price. This situation simply reflects the dearth of stocks on hand.

Sales during the last week comprised some large transactions for export, both to Canada and to Europe. The politico-labor trouble in Spain, of which news was received on Friday, was considered to be likely to interfere with the supply of Spanish lead, and this was viewed as a factor of great potential important in the market, it being regarded as unlikely that the Australian producers can fill the demand in the absence of the Spanish.

Spelter—With the beginning of our week of record this market was turned and a sharp rally ensued. When the price had fallen to about 8c., it was considered that the mar-

DAILY PRICES OF METALS IN NEW YORK

July	Sterling Exchange	Silver, Cts. per Oz.	Copper	Tin	Lead		Zinc
			Electrolytic, Cts. per Lb.	Spot, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.	St. Louis, Cts. per Lb.
13	4.7569	62⅞	22½ @23½	39½	6.30 @6.40	6.12½ @6.25	8.00 @8.37½
14	4.7569	62⅛	22½ @23½	38⅝	6.30 @6.40	6.12½ @6.25	8.12½ @8.50
15	4.7569	61⅞	22½ @23½	38⅝	6.25 @6.35	6.05 @6.15	8.12½ @8.50
17	4.7569	62⅛	22½ @23½	38⅛	6.25 @6.35	6.05 @6.15	8.25 @8.75
18	4.7569	62⅜	22½ @23½	37⅛	6.25 @6.50	6.12½ @6.25	8.37½ @8.87½
19	4.7575	62⅛	22½ @23½	37⅛	6.25 @6.50	6.12½ @6.25	8.37½ @8.87½

The quotations herein are our appraisal of the average markets for copper, lead, spelter and tin based on wholesale contracts for the ordinary deliveries of the trade as made by producers and agencies; and represent, to the best of our judgment, the prevailing values of the metals, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The price quoted for copper on "regular terms" (r.t.) is the gross price including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Prime Western brands. Only the St. Louis price is herein quoted, St. Louis being the basing market. We quote the New York price at 17c. per 100 lb. above the St. Louis price.

Silver quotations are as reported by Handy & Harman and are in cents per troy ounce of silver bars 999 fine.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c.

LONDON

July	Silver	Copper				Tin		Lead		Zinc	
		Standard		Electrolytic							
		Spot	3 Mos.	£ per Ton	Cts. per Lb.	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts. per Lb.
13	30	90½	89	125	26.61	169¾	170¾	28¼	6.02	45½	9.63
14	29⅞	91	89½	124½	26.45	169	169¾	28¼	6.02	47	10.01
15	29 9/16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
17	29 11/16	88	86½	122	25.98	166¼	167¼	28¼	6.02	48	10.22
18	29⅞	88	87	122	25.98	163¼	164¼	28¼	6.07	48	10.22
19	29⅞	89	87	122	25.98	163	163¼	28¼	6.07	50	10.65

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for electrolytic, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2,240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21⅓c.

ket had become unduly depressed and support was given from powerful quarters. The advance was assisted by short covering and also by some buying from abroad. Some purchases were made also by domestic consumers, including galvanizers, but on the whole this business was not large. However, the aggregate of business of all kinds attained considerable proportions. With the advance in price producers who had previously been sellers withdrew and the market is now in the position of waiting to see if a more general buying movement will develop among consumers that will carry the advance further or at least hold prices where they are. At the close July spelter was quoted at about 8⅞c., August at about 8⅞c. and September at 8⅝@8⅝c. Producers continue to be sellers for delivery in the fourth quarter at relatively low prices. The market closed dull and barely steady.

It was reported on July 19 that Hayden, Stone & Co. had acquired a predominant interest in the American Zinc, Lead and Smelting Co., and that changes in the board of directors thereof would be announced in the course of a few days.

The United Zinc Smelting Corporation plans to erect a new smeltery on the Ohio River about 10 mi. from Wheeling. The first unit of the new plant will have capacity for smelting about 20,000 tons of ore per annum, producing about 8,500 tons of spelter. The plant will comprise a sulphuric acid department.

Zinc Sheets continue in good demand and firm. The price is unchanged, the base being $15 per 100 lb., f.o.b. Peru, Ill., less 8% discount.

Other Metals

NEW YORK—July 19

Aluminum has been rather more active, with moderate sales and more inquiry. Prices are a little firmer, the current quotation being 59@61c. per lb. for No. 1 ingots, New York.

Nickel—There is no change, demand for domestic use being about as usual, with some inquiries for export. Quotations are 45@50c. per lb. for ordinary forms, according to size and terms of order. Electrolytic nickel brings 5c. per lb. premium.

Antimony—One order for about 400 tons was reported placed by munition manufacturers, but in view of the large stock on hand this business did not relieve the market, which declined further. We quote 14¼@14¾c. for spot, and 12½c. in bond for shipment from China within 30 days.

Quicksilver—This market was dull and lower. We quote $80, New York. San Francisco reports by telegraph $80, market dull. London is unchanged at £17 10s.

Gold, Silver and Platinum

Silver—The market shows a slight sagging tendency owing to lack of inquiry on Eastern account. Supplies in London seem sufficient to meet current mintage orders without advancing price.

Mexican dollars were quoted in New York on July 13 at 48⅜@51⅜c.; July 14 at 48⅛@51⅛c.; July 15 at 47¾@57c.; July 17 at 48¼@52¼c.; July 18 at 48@52c.; July 19 at 47¾@52c. Pesos are not very plentiful just now.

Platinum—This market was quiet and but little changed. Early in the week sales at $62 were reported. At the close the quotation was $60. We quote $61 as the average for the week.

PLATTEVILLE, WIS.—July 15

The base price paid this week for zinc ore was $65@60 per ton 60% zinc for top grades down to $53 per ton for medium grades, assaying down to 50%. The base price paid for lead ore was $74 per ton for 80% ore.

SHIPMENTS, WEEK ENDED JULY 15

	Zinc Ore, Lb.	Lead Ore, Lb.	Sulphur Ore, Lb.
Week	5,490,000	130,000	966,300
Year	130,306,000	4,643,840	31,791,900

Shipped during week to separating plants, 5,086,000 lb. zinc ore.

JOPLIN MO.—July 15

Blende, high price, $77.30; per ton 60% zinc, premium ore, $75; medium, $70@60; low, $55. Calamine, per ton 40% zinc, $55@45; average selling price, all grades of zinc, $68.24 per ton. Lead, high price, $77.70; base, $75 per ton 80% metal content; average selling price, all grades of lead, $73.20 per ton.

SHIPMENTS WEEK ENDED JULY 15

	Blende	Calamine	Lead	Values
Totals this week.	11,061,690	309,430	2,170,710	$467,460
Totals this year.	382,453,570	30,121,490	65,753,240	23,399,960

Blende value, the week, $381,330; 28 weeks, $19,416,950.
Calamine value, the week, $6,650; 28 weeks, $1,063,880.
Lead value, the week, $79,480; 28 weeks, $2,919,130.

Another drop in production was made by closing down additional mines, and it is now under 7,000 tons per week. Sellers were seeking buyers this week at any price, and buying of grades free of lead was increased slightly, but the bulk of the purchasing agencies are on light buying orders, with representatives of the smaller smelters out of the market entirely. The bin stock, around 25,000 tons, prevents any hopes for an advancing ore market, even though spelter should become firmer.

OTHER ORES

Manganese Ore for 1917 delivery is held by Brazilian producers at 40c. per unit at port. At current rates of freight this is equal to about 75c. per unit at Baltimore or Philadelphia. Indian manganese ore has been offered at 70@72c. per unit at Atlantic ports.

Antimony Ore—Buyers are reluctant to enter into contracts except on the basis of the price for antimony metal during the month of delivery. The proposed ratio, however, makes it ultimately impossible to produce antimony ore in Bolivia and South America in general and no new business has been done from that quarter for some time.

Tungsten Ore—The ideas of buyers and sellers appear to be as far apart as they were last week, but sales effected enable the market to be more accurately gaged. A 20-ton lot was sold during the week at $27 per unit. There were bids for a 30-ton lot, besides some smaller lots, at $25, but those orders could not be executed, the sellers holding for higher prices. In all of these cases spot delivery was required. France is reported to be in the market for tungsten ore at about $20 per unit, and as the quantity wanted is believed to be considerable this underlying demand is regarded as likely to prevent prices from receding much further.

Iron Trade Review

NEW YORK—July 19

The only new business of any size during the week has been for export, no domestic orders of importance having come forward.

The only incident is the placing of large contracts by manufacturers of agricultural machinery. It is understood that most of these were taken at 2.35c. for bars and 2.50@2.60c. for small shapes. The contracts were hardly as large as usual at this season. It is understood that there were objections to the prices.

Structural steel is still rather backward and slow. New construction projects seem to be held back. Some large ones are under discussion, but have not reached the order stage.

Pig iron has been rather quiet, which seems unusual in view of the large output of steel. The most pressing demand just now is for bessemer pig for export. The right quality is scarce.

Iron and Steel Exports from the United States in May and the five months ended May 31 are valued by the Department of Commerce as below. The figures also include the tonnage of those commodities which are reported by weight:

	May		Five Months	
	1915	1916	1915	1916
Iron and steel, tonnage	263,736	540,591	944,589	2,109,602
Machinery, value	$10,214,062	$21,984,961	$46,280,561	$84,025,614
Total value	$26,536,612	$72,918,913	$144,683,288	$431,839,320

The total value includes that of all iron and steel products. Imports of iron and steel in May so far as reported by tonnage were 28,917 tons in 1915 and 32,113 in 1916. For the five months ended May 31 they were 114,604 tons this year.

Exports from Baltimore for the week included 2,828,069 lb. steel bars and wire rods and 162,000 lb. tinplate to Great Britain; 16,977,025 lb. steel billets, 5,181,875 lb. steel bars to France; 3,533 long tons pig iron, 50 tons scrap and 1,235 tons barbed wire to Italy.

PITTSBURGH—July 18

There is a further curtailment in steel production on account of still hotter weather, some mill managers estimating their output in the past three or four days as fully 20% below the normal rating, entirely on account of the heat. The demand for steel is not correspondingly reduced and the pressure upon the mills is very heavy.

The steel market itself is still quieter, being practically stagnant. There is not the slightest weakness in the regular steel mill prices for forward deliveries, but if anything a trifle more strength and a stronger conviction that these prices will not yield at any time this year. Even in this dull market the mills are selling considerable steel, whereby it will take a long time to catch up with deliveries when they are already filled for months.

A feature of the steel market for two or three months past has been the decrease in premiums demanded for certain steel products for early delivery. The latest development is a stiffiening in some of these premiums. Plates for early shipment, for instance, are stronger at 4.00c. than they were two or three weeks ago, and bars and shapes are not offered at base prices for as early deliveries as a month ago.

The export demand continues very heavy. There is constant inquiry for bessemer pig iron, while all unfinished steel offered, in the form of ingots, billets, sheet bars, etc., both soft steel and of shell quality, is eagerly bought up if the delivery is early enough. From neutral countries there is continued heavy demand for regular steel products.

Pig Iron—The market is stagnant, but with prices well maintained by furnaces. Bessemer iron is being sold almost daily for export, generally in lots of 1,000 to 5,000 tons, and sometimes higher than $21, Valley, is realized. Ella Furnace at West Middlesex went out of blast Friday through an accident, the bell dropping into the furnace. Struthers is not yet in, although expected by July 1. We quote: Bessemer, $21@21.50; basic, $18@18.25; foundry and malleable, $18.25@18.50; forge, $18@18.25, f.o.b. Valley furnaces, 95c. higher delivered Pittsburgh.

Steel—The market for unfinished steel continues strong and on the whole is stronger than a month or six weeks ago. The export demand is very heavy and prospects are that in the second half of this year considerably more than 1,000,000 tons will be exported, in soft steel and shell quality, in the form of ingots, blooms, billets and sheet bars. Domestic demand is light and is limited to very early deliveries, but it is hard to buy steel at any price. We quote soft steel at $42@43 for bessemer and $44@45 for openhearth, rods being $55@60 and forging billets $65@70 per ton.

FERROALLOYS

Ferromanganese—The market continues very quiet, with prompt at $200@225 and contract at $175. Earlier deliveries than formerly are offered at the contract price.

Production of Ferromanganese and Spiegel in the United States in the six months ended June 30 is estimated at 88 571 tons in 1915, and 184,434 tons in 1916; an increase of 95,863 tons this year.

Imports at Baltimore for the week included 1,832 tons ferromanganese from Liverpool.

Spiegeleisen continues in good demand but is more plentiful for early delivery. Quotations for ordinary 20% grade are $45@50 per ton at furnace.

Ferrosilicon continues steady at $83@85 per ton at furnace for 50% grade. Bessemer ferrosilicon ranges from $33 for 10% up to $43 for 16% per ton at furnace.

FOREIGN IRON

Italian Iron and Steel Imports in 1915 were 690,499 metric tons in 1915, against 669,412 tons in 1914 and 741,847 tons in 1913. The larger items in 1915 were 261,696 tons scrap, 240,365 tons pig iron, 72,391 tons bars and rods and 64,032 tons steel billets and blooms.

Pig-Iron Production in Germany in May is reported by the German Iron and Steel Union at 1,112,574 metric tons, being 38,868 tons more than in April and 126,606 tons more than in May, 1915. For the five months ended May 31 the total was 5,413,525 tons in 1916, against 4,540,841 tons in 1915 and 7,756,534 tons in 1914. The make this year was 69.8% of that in the first part of 1914, before the war began.

IRON ORE

Of the Lake iron ore shipments in June, 7,823,404 tons, or 82.3% of the total, went to Lake Erie ports. Receipts at South Chicago for the month were 1,180,368 tons; at Gary, 317,148 tons.

Shipments from Lake Erie docks to furnaces in June were 5,698,128 tons. Dock stocks of ore on July 1 were 3,983,197 tons, a decrease of 2,137,327 tons from last year.

Imports of iron ore in the United States in May were 148,599 gross tons, being 49,625 tons more than in May, 1915. For the five months ended May 31 the imports were 432,996 tons in 1915 and 501,873 tons in 1916; increase, 68,877 tons. Of the imports this year 277,126 tons, or about 55%, were from Cuba.

SAULT STE. MARIE CANALS

Freight pasing through the Sault Ste. Marie canals in June was 12,960,409 net tons. For the season to July 1 the total freight was: East bound, 21,978,577; west bound, 5,490,730; total, 27,469,307 tons, an increase of 10,325,173 tons over last year. The total number of vessel passages this year was 7,597, showing an average cargo of 3,616 tons. The mineral freights included in the totals were, in short tons except salt which is in barrels:

	1915	1916	Changes
Anthracite	678,852	616,558	D. 62,294
Bituminous coal	3,022,437	4,372,197	I. 1,349,760
Iron ore	11,072,607	18,481,159	I. 7,408,552
Pig and manufactured iron	75,205	70,585	D. 4,620
Copper	43,272	30,807	D. 12,465
Salt, bbl.	232,173	288,090	I. 55,917

Of the vessels passing this year 1,981 went through the Canadian canal and 5,576 through the United States canal.

COKE

Coke production in the Connellsville region for the week is reported by the "Courier" at 359,330 net tons; shipments, 362,692 tons. Shipments of Greensburg and Upper Connellsville districts, 34,054 tons. Production was kept down by holidays and by the extreme head.

Coke production of the Connellsville region for the six months ended June 30 was 7,336,544 net tons in 1915, and 11,313,322 tons in 1916; an increase of 3,976,778 tons, or 54.2%, this year. The half year closed with practically no coke stocked.

Connellsville—Coke continues scarce, on account of production being curtailed by hot weather, and most operators and merchants are having some difficulty in maintaining full shipments under contract. Brokers have been buying spot furnace coke in a limited way, paying $2.65@2.75, while consumers art not in evidence. Production is expected to increase somewhat as the men become more accustomed to the heat, while within two or three months there will be additional byproduct capacity completed. We quote: Prompt furnace, $2.65@2.75; contract, $2.35@2.50; spot foundry, $3@3.25; contract, $3.25@3.50, per net ton at ovens.

Coal Production in Spain for the year ended Dec. 31 is reported as below, in metric tons:

	1914	1915	Changes
Bituminous coal	3,905,080	4,234,798	I. 329,718
Anthracite	228,302	252,483	I. 24,181
Lignite	309,473	347,072	I. 37,599
Total	4,442,855	4,834,353	I. 391,498

Imports—chiefly from Great Britain—were 2.875,763 tons in 1914, and 1,930,000 tons in 1915; a decrease of 945,763 tons.

Chemicals

NEW YORK—July 19

The usual midsummer dullness is on the general market and only moderate business is reported. There has been some reselling of speculative holdings of heavy chemicals, which has tended to demoralize the market.

Arsenic—Demand has been light but stocks are small and prices are fairly well maintained. Quotations are $6@6.25 per 100 lb., according to size and terms of order.

Copper Sulphate—Demand has been on a small scale and prices are again weaker. Quotations are $9@10 per 100 lb. for large lots. There are reports of lower prices made on speculative holdings, but they are not verified.

Magnesite—Imports at Baltimore for the week included 900 tons magnesite from Port Spain.

Nitrate of Soda—Advices from South America report that prices there are weak, owing to heavy stocks and trouble about securing vessels. The market here has been rather quiet but firm, and a fair business has been done at $3.05@3.10 per 100 lb. for both spot and future.

Sulphate of Ammonia—Demand is not active and the market holds at about $3.40 per 100 lb. for domestic. Imports have been light. The production of sulphate of ammonia in the United States in 1915 was 220,000 short tons.

Sulphuric Acid—The market has been easy owing to increased offers, but prices are steady, 60-deg. acid selling at $20 per ton at works, and 66-deg. acid at $35 per ton for spot.

PETROLEUM

The Interior Department has approved the new leases of the Osage Indian oil lands in Oklahoma as recently put up at auction. Under the terms of the new leases the Osages will receive in royalties one-sixth of the output from wells producing less than 100 bbl. per day, and one-fifth that from wells flowing over 100 bbl.; also a rental of $1 per acre yearly on undeveloped land. Sales at auction of about 15,000 acres of producing lands formerly leased to operators realized about $3,233,000 in addition to the royalties.

New gas leases have also been made, covering about 800,000 acres. Under the old leases the rental was $100 yearly for each producing well. Under the new leases the royalty is 3c. per 1,000 cu.ft., which will produce a much higher rental.

Assessments

Company	Delinq.	Sale	Amt.
Algomah, Mich.	May 18	.....	$1.00
Blue Bell, Ida.	July 8	Aug. 5	0.002
Bullion, Ida.	July 10	July 31	0.01
Cedar Creek, Ida.	July 5	Aug. 5	0.01
Clear Grit, Ida.	Aug. 7	Aug. 25	0.002
Columbus Ext., Utah	July 13	Aug. 8	0.02
Cons. Imperial, Nev.	July 18	Aug. 10	0.01
Cons. Virginia, Nev.	July 27	Aug. 07	0.05
Crackerjack, Nev.	July 3	Aug. 1	0.01
Four Timbers, Ida.	July 26	Aug. 26	0.002
Friend, Ida.	June 30	July 20	0.002
Gold Mt. Champion, Utah	July 20	Aug. 10	0.0025
Gould & Curry, Nev.	July 14	Aug. 3	0.03
Great Western, Nev.	July 24	Aug. 15	0.005
Hope, Calif.	July 17	Aug. 14	0.01
Hugo, Ida.	July 29	Aug. 30	0.002
Independence, Ida.	July 8	July 29	0.001
Iron Spar, Ida.	July 17	Aug. 15	0.003
Jack Waite, Ida.	July 27	Aug. 28	0.01
Kewanas Reor., Nev.	Aug. 2	Sept. 6	0.01
Lucky Calumet, Ida.	July 20	Aug. 21	0.005
Morgan Argentine, Utah.	July 15	Aug. 5	0.01
Nevada-Douglas, Nev.	July 15	Aug. 16	0.10
North Lake, Mich.	June 14	.....	1.00
Old Veteran, Ida.	July 8	Aug. 5	0.002
Sierra Nevada, Nev.	July 11	Aug. 3	0.10
Silver Moon, Ida.	July 8	Aug. 3	0.005
Silver Pick, Nev.	July 5	Aug. 14	0.01
Southern Swansea, Utah	July 17	Aug. 5	0.001
Spearhead Reor., Nev.	July 3	Aug. 3	0.01
Sunrise ,Ida.	July 27	Aug. 28	0.002
Swansea Ext., Utah.	July 10	Aug. 1	0.0025
Tar Baby, Utah.	Aug. 3	Sept. 4	0.01
Tarbox, Mont.	July 25	Aug. 12	0.005
Tiberius, Ida.	July 8	Aug. 1	0.001
Tintic Central, Utah.	July 12	Aug. 8	0.005
Ton. Gypsy Queen, Nev.	July 11	Aug. 15	0.01
Uvada, Nev.	June 24	July 27	0.02
Victoria, Utah.	July 8	Aug. 2	0.005
Wallace, Ida.	June 29	July 29	0.0025
Wasatch-Utah, Utah.	June 19	July 22	0.0025
West Mercur, Utah.	July 8	July 31	0.025
Wolf Mt. Copper, Utah.	Aug. 2	Sept. 6	0.005

Stock Quotations

SAN FRANCISCO July 18 Name of Comp.	Bid.
Alta.	.05
Andes.	.11
Best & Belcher.	.05
Bullion.	.02
Caledonia.	‡.44
Challenge Con.	.05
Confidence.	.18
Cons. Imperial.	‡.01
Con. Virginia.	.08
Gould & Curry.	.03
Hale & Norcross.	.07
Jacket-Cr. Pt.	.02
Mexican.	.15
Occidental.	.70
Ophir.	.22
Overman.	.05
Savage.	.05
Seg Belcher.	.02
Sierra Nevada.	.31
Union Con.	.71
Utah Con.	.01
Belmont.	4.00
Jim Butler.	.85
MacNamara.	.04
Midway.	.19
Mont.-Tonopah.	.25
North Star.	.12
Rescue Eula.	.25
West End Con.	.90
Atlanta.	.10
Blue Bell.	.01
Booth.	.14
C.O.D. Con.	.02
Comb. Frac.	.06
D'field B.B.	.02
D'field Daisy.	.02
Jumbo Extension.	.76
Pitts.-Silver Peak.	.06
Round Mountain.	.50
Sandstorm Kendall.	.03
Silver Pick.	.10
Central Eureka.	.10
Argo.	.07
Ariz. Central.	.13
Big Jim.	.67½
Lazy Boy.	.10
Oatman No. Star.	‡.17
Tom Reed.	1.60
United Eastern.	3.50
United Western.	.09

LONDON July 6	
Alaska Tre'dwell	£5 17s 6d
Burma Corp.	3 1 3
Cam & Motor.	0 14 3
Camp Bird.	0 9 3
El Oro.	0 9 6
Esperanza.	0 11 0
Mexico Mines.	4 0 0
Nechi, pfd.	0 14 9
Oroville.	0 17 6
Santa Gert'dis.	0 14 0
Tomboy.	1 3 0

SALT LAKE July 18 Name of Comp.	Bid.
Alta Con.	.35
Black Jack.	.05
Colorado Mining.	.17
Crown Point.	.04½
Daly-Judge.	7.05
Emma Cop.	.43
Gold Chain.	.24
Grand Central.	.62
Iron Blossom.	1.50
Lower Mammoth.	.04
May Day.	.12½
Opohongo.	.01½
Prince Con.	1.30
Seven Troughs.	.02½
Silver King Coal'n.	3.02½
Silver King Con.	3.25
Sioux Con.	.10
Uncle Sam.	.06
Yankee.	.20

COLO. SPRINGS July 18	
Acacia.	.03½
Doctor Jack Pot.	.08½
Elkton Con.	.15
El Paso.	.75
Findlay.	.03½
Gold Sovereign.	.03½
Golden Cycle.	2.07
Granite.	.64
Isabella.	.17½
Jack Pot.	.05
Jerry Johnson.	.04½
Mary McKinney.	.30
Portland.	1.67½
Vindicator.	2.00

TORONTO July 18	
Adanac.	1.85
Bailey.	.06
Chambers Ferland.	.20
Coniagas.	4.50
La Rose.	.56
Peterson Lake.	.22
Right of Way.	.03
Seneca Superior.	.35
T. & Hudson Bay.	50.00
Temiskaming.	.52
Trethewey.	‡.21
Wettlaufer-Lor.	.12
Dome Exten.	.04
Dome Lake.	.31
Foley O'Brien.	.50
Hollinger.	29.00
Imperial.	‡.03
Jupiter.	.27
McIntyre.	1.47½
Porcu. Crown.	.68½
Preston E. D.	‡.03
Vipond.	.40
West Dome.	.34

N. Y. EXCH. July 18 Name of Comp.	Clg.
Alaska Gold M.	18
Alask a Juneau.	8
Am.Sm.&Ref.,com.	92½
Am. Sm. & Ref., pf.	110
Am. Sm. Sec., pf. A	93
Am. Sm. Sec., pf. B.	85
Am. Zinc.	32½
Am. Zinc, pf.	62
Anaconda.	78½
Batopilas Min.	1½
Bethlehem Steel.	435
Bethlehem Steel, pf.	130
Butte & Superior.	65
Chile Cop.	20
Chino.	46½
Colo. Fuel & Iron.	42½
Crucible Steel.	66
Dome Mines.	25½
Federal M. & S.	12
Federal M. & S., pf.	38
Great Nor., ore ctf.	34½
Greene Cananea.	46
Homestake.	130
Inspiration Con.	47½
International Nickel	44½
Kennecott.	45½
Lackawanna Steel.	68½
Miami Copper.	34½
Nat'l Lead, com.	63½
National Lead, pf.	113½
Nev. Consol.	16
Ontario Min.	6½
Quicksilver.	2½
Quicksilver, pf.	4½
Ray Con.	21½
Republic I&S, com.	43½
Republic I&S, pf.	108
Sloss-Sheffield.	39½
Sloss-Sheffield, pf.	94½
Tennessee Copper.	24½
Utah Copper.	75½
U. S. Steel, com.	84½
U. S. Steel, pf.	117½
Va. Iron C. & C.	40

N. Y. CURB July 18	
Beaver Con.	.36
Buffalo Mines.	.80
Butte & N. Y.	1½
Butte C. & Z.	4½
Caledonia.	.66
Can. Cop. Corpn.	1½
Cashboy.	.05
Cerro de Pasco.	35
Con. Ariz. Sm.	1 1/16
Con. Coppermines.	2½
Con. Nev.-Utah.	1/16
Crystal Cop.	.90
First Nat. Cop.	4½
Florence.	.45
Goldfield Con.	.88
Goldfield Merger.	.09
Granite.	.28
Hecla Min.	5 1/16
Howe Sound	4½
Jerome Verde.	1 1/16
Joplin Ore & Spel.	2½
Kerr Lake.	4½
Magma.	13½
Majestic.	½
McKinley-Dar-Sa.	.55
Mother Lode.	.27½
Nevada Hills.	.15
N. Y. & Hond.	15½
Nipissing Mines.	6½
Oro.	.04
Ray Hercules.	3½
Rochester Mines.	.57
St. Joseph Lead.	14½
Standard S. L.	1½
Stewart.	.25
Success.	.58
Tonopah.	5½
Tonopah Ex.	5½
Tribullion.	1/16
United Zinc.	6½
White Knob, pf.	1½
Yukon Gold.	2½

BOSTON EXCH July 18 Name of Comp.	Bid
Adventure.	2½
Ahmeek.	92
Algomah.	1½
Alloues.	57½
Aris. Com., ctfs.	8½
Bonanza.	.25
Butte-Balaklava.	2
Calumet & Ariz.	66½
Calumet & Hecla.	515
Centennial.	13½
Copper Range.	55½
Daly West.	2½
East Butte.	11½
Franklin.	6½
Granby.	81
Hancock.	11
Helvetia.	.20
Indiana.	2½
Island Cr'k, com.	45
Island Cr'k, pfd.	88
Isle Royale.	25
Keweenaw.	3½
Lake.	11
La Salle.	‡1
Mason Valley.	1½
Mass.	11½
Mayflower	2½
Michigan.	2½
Mohawk.	80½
New Arcadian.	5½
New Idria.	‡11½
North Butte.	20½
North Lake.	1½
Ojibway.	.75
Old Colony.	1½
Old Dominion.	61
Osceola.	80
Quincy.	82
St. Mary's M. L.	72
Santa Fe.	1½
Shannon.	7½
Shattuck-Aris.	25
So. Lake.	4½
So. Utah.	.16
Superior.	12½
Superior & Bost.	3½
Tamarack.	38
Trinity.	4½
Tuolumne.	.37
U. S. Smelting.	67½
U. S. Smelt'g, pf.	49½
Utah Apex.	3½
Utah Con.	12½
Utah Metal.	6½
Victoria.	3
Winona.	4½
Wolverine.	48
Wyandot.	1½

BOSTON CURB July 18	
Bingham Mines.	9½
Boston Ely.	1 1/16
Boston & Mont.	.96
Butte & Lon'n Dev.	.67
Calaveras.	4½
Calumet-Corbin.	.03
Chief Con.	1½
Cortez.	.40
Crown Reserve.	.50
Davis-Daly	1½
Eagle & Blue Bell.	1½
Houghton Copper.	1½
Iron Cap Cop., pf.	5½
Mexican Metals.	.23
Mines of America.	2½
Mojave Tungsten.	4
Nat. Zinc & Lead.	1½
Nevada-Douglas.	1
New Baltic.	1½
New Cornelia.	12½
Ohio Copper.	.10
Oneco.	.80
Raven Copper.	.06
Rex Cons.	.18½
Rilla.	.23
United Verde Ext.	28½

‡Last Quotations.

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1914	1915	1916	1914	1915	1916
January.	56.572	48.855	56.775	26.553	22.731	26.960
February.	57.506	48.477	56.755	26.573	22.753	26.975
March.	58.067	50.241	57.935	26.788	23.708	27.597
April.	58.519	50.250	64.415	26.958	23.709	30.662
May.	58.175	49.915	74.269	26.704	23.570	35.477
June.	56.471	49.034	65.024	25.948	23.267	31.060
July.	54.678	47.519	.....	25.219	22.597	.....
August.	54.344	47.163	.....	25.979	22.780	.....
September.	53.290	48.680	.....	24.260	23.591	.....
October.	50.654	49.385	.....	23.199	23.925	.....
November.	49.082	51.714	.....	22.703	25.094	.....
December.	49.375	54.971	.....	22.900	26.373	.....
Year.	54.811	49.684	.....	25.314	23.675	.....

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York Electrolytic		London Standard		London Electrolytic	
	1915	1916	1915	1916	1915	1916
Jan.	13.641	24.008	60.756	88.083	65.719	116.167
Feb.	14.394	26.440	63.494	102.667	*	133.167
Mar.	14.787	26.310	66.152	107.714	*	136.000
April.	16.811	27.895	75.096	124.319	*	137.389
May.	18.506	28.625	77.600	135.457	*	152.522
June.	19.477	26.601	82.574	112.432	95.333	137.455
July.	18.796	.....	76.011	.....	91.409	.....
Aug.	16.941	.....	68.673	.....	82.333	.....
Sept.	17.502	.....	68.915	.....	85.250	.....
Oct.	17.686	.....	72.601	.....	88.000	.....
Nov.	18.627	.....	77.744	.....	93.273	.....
Dec.	20.133	.....	80.773	.....	100.43	.....
Year.	17.275	.....	72.532	.....	.....	.....

TIN

Month	New York		London	
	1915	1916	1915	1916
January.	34.260	41.825	156.550	175.548
February.	37.415	42.717	176.925	181.107
March.	48.426	50.741	180.141	193.609
April.	47.884	51.230	166.225	199.736
May.	38.790	49.125	162.675	196.511
June.	40.288	42.231	167.636	179.466
July.	37.423	.....	167.080	.....
August.	34.389	.....	151.440	.....
September.	33.125	.....	152.625	.....
October.	33.080	.....	151.554	.....
November.	39.224	.....	167.670	.....
December.	38.779	.....	167.000	.....
Av. year.	38.590	.....	163.960	.....

LEAD

Month	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
January.	3.729	5.921	3.548	5.826	18.606	31.167
February.	3.827	6.246	3.718	6.164	19.122	31.988
March.	4.053	7.136	3.997	7.375	21.883	34.440
April.	4.221	7.630	4.142	7.655	21.094	34.368
May.	4.274	7.463	4.182	7.332	20.347	32.967
June.	5.932	6.936	5.836	6.749	25.170	31.011
July.	5.659	.....	5.531	.....	24.611	.....
August.	4.656	.....	4.520	.....	21.946	.....
September.	4.610	.....	4.490	.....	23.151	.....
October.	4.600	.....	4.499	.....	23.994	.....
November.	5.155	.....	5.078	.....	26.278	.....
December.	5.355	.....	5.266	.....	28.807	.....
Year.	4.673	.....	4.567	.....	22.917	.....

SPELTER

Month	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
Jan.	6.386	16.915	6.211	16.745	30.844	89.810
Feb.	8.436	18.420	8.255	18.260	39.819	97.762
Mar.	8.541	16.846	8.360	16.676	44.141	95.048
April.	10.012	16.695	9.837	16.525	49.888	99.056
May.	14.781	14.276	14.610	14.106	68.100	94.217
June.	21.208	11.752	21.038	11 582	100.614	68.591
July.	19.026	.....	18.856	.....	97.250	.....
Aug.	12.781	.....	12.611	.....	67.786	.....
Sept.	13.440	.....	13.270	.....	67.841	.....
Oct.	12.800	.....	12.596	.....	66.536	.....
Nov.	15.962	.....	15.792	.....	88.409	.....
Dec.	15.391	.....	15.221	.....	89.400	.....
Year.	13.230	.....	13.054	.....	67.553	.....

New York and St. Louis quotations, cents per pound, London, pounds sterling per long ton. * Not reported.

PIG IRON IN PITTSBURGH

Month	Bessemer‡		Basic‡		No. 2 Foundry	
	1915	1916	1915	1916	1915	1916
January.	$14.59	$21.60	$13.45	$18.78	$13.90	$19.70
February.	14.55	21.16	13.45	18.93	13.90	19.51
March.	14.55	21.81	13.45	19.20	13.95	19.45
April.	14.55	21.65	13.45	18.95	13.95	19.45
May.	14.61	21.78	13.60	19.11	13.83	19.58
June.	14.70	21.95	13.67	18.95	13.77	19.34
July.	14.94	.....	13.91	.....	13.68	.....
August.	16.01	.....	15.31	.....	14.75	.....
September.	16.86	.....	15.95	.....	15.70	.....
October.	16.95	.....	15.96	.....	15.80	.....
November.	17 57	.....	16.47	.....	17.20	.....
December.	19.97	.....	18.44	.....	18.95	.....
Year.	$15.82	.....	$14.76	.....	$14.95	.....

‡As reported by W. P. Snyder & Co.